Metal Treating

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Metal Treating

THE ONLY MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

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About Our Cover

Pointing to the unlimited horizon of the missile field is a photograph of the MACE TM 76 Missile supplied through the courtesy of the Martin Company, Baltimore, Maryland. For the story of the heat treatment of the basic materials for this missile see page 2.

HEAT TREATMENT OF METALS AT MARTIN-BALTIMORE

AS APPLIED

TO THE

MACE TM 76 MISSILE

FRANK SNYDER

Senior Manufacturing Engineer
The Martin Company-Baltimore Division
Baltimore, Maryland

FIG. 1. Modern electric furnace used by the Martin Company for aging and annealing aluminum, and stress relieving steel parts.

The basic materials that go into the Mace TM 76 Missile at Martin-Baltimore include many ferrous and non-ferrous alloys. These are heat treated to obtain tensile values ranging from 45,000 to 220,000 p.s.i., depending upon the alloy and the specific requirements. A decided advantage in processing the aluminum parts is a free-fall system of quenching.

Ferrous metals used are 431 stainless steel, 1095 carbon alloy steel and the heat treatable low alloys such as 4130 and 4340. Principal non-ferrous metals are aluminum alloys in the forged, rolled, extruded and cast conditions. The leading materials used in the wrought condition include 2014T6, 7075T6 and 2024T4 alloys, while the casting metals are 355T6 and 356T6 aluminum alloys.

Heat treatment of both the aluminum and steel alloys is carried out in carefully controlled furnaces that are checked monthly by the Quality Control Laboratory. This insures that requirements of the applicable military specifications are met for the particular material being processed. In most cases, furnace temperatures are controlled at plus or minus 10° F. to maintain uniformity of repeated heat-treat cycles.

Heat treatment of steel is accomplished in electric furnaces ranging in size up to 8 ft. by 8 ft. by 12 ft., with adequate oil and water-quenching facilities, with suitable temperature control in the 2,100 gallon oil circulating system to maintain bath temperatures within the specific heat-treat process.

Salt bath furnace equipment is generally used for solution heat treatment of wrought aluminum alloys, and electric air-circulating equipment serves in the aging operations. Maximum size of these furnaces is 4 ft. by 7 ft. by 16 ft. for heat treating and 6 ft. by 6 ft. by 20 ft. for the aging process.

Through the free-fall system of quenching aluminum, the operation is accelerated to the extent that distortion, which is a normal by-product of heat treating, is practically eliminated.

Free-Fall Principles

There are well established physical principles which make the free-fall method superior to the conventional basket method of lowering heat treated parts into the quench. The speed at which basket held parts are lowered into the quench water is very slow, usually 30 feet-per-minute or 0.5 feet-per-second. As the basket strikes the water it generates a steam cloud in which droplets of water are hammered against one side of the sheet metal parts in the basket. As these droplets vaporize on contact with the hot metal, they absorb the heat and the part is cooled differentially. The part contracts and becomes concave toward the cooled side. Meanwhile the yield strength of the cooled side is increased (75 S aluminum increases from 4,500 p.s.i. at 700° F. to 20,000 p.s.i. at 75° F. (SW)) causing the contracted, concave side to harden before the convex side starts cooling. This process, which occurs while the part is slowly lowered into the quench water, causes distortion.

In free-fall quench, no steam cloud is generated from

the rack. Steam hammering is minimized when the parts fall freely into the water. Quenching is more uniform because the contracting forces on both sides of the sheet are in better balance when the part is quickly submerged and no area of it is partially in and partially out of the water long enough for differential contraction to take place.

These factors are the key to the success of free-fall quenching. The table below illustrates the high speed attained in free-falling. Compare these with the 0.5 feet-per-second of the basket method.

TABLE 1

Height Dropped (ft.)	Time to Quench (sec.)	Speed at Water Surface (ft./sec.)
1	0.25	8
2	0.35	11
3	0.43	14
4	0.50	16
5	0.56	18
6	0.61	20

Technique

The proper positioning of the detail parts with respect to the vertical and horizontal axes involves considerable operator skill and experience. Several points found useful are given below in order of importance.

1. *Drop parts from a 1 to 4 ft. height.* Parts dropped too high will strike the water at an oblique angle and float on the surface. Surface hesitation results in distortion. Parts dropped too low will not have the acceleration benefit of free-fall. The actual distance from part bottom to water level is variable depending on the way the part shape influences the speed past the water surface.

2. *Hang parts to cut water.* Parts are hung in such a position as to knife the water with a minimum of back-splash. This experience is easily gained by experimentally dropping cold parts into the quench water and observing the wake. In some cases, back-splash is so slight that parts can be strung one above the other.

3. *Minimize horizontal dimension.* It is found that if the horizontal dimension is minimized the advantages of both free-fall and vertical quenches are obtained. Overall distortion is less.

4. *Use adequate spacing.* Part spacing ranges from 3 to 12 in. by 1 in. on up, depending on size. Parts are racked so their major surfaces do not touch or entrap steam at the water surface. This prevents surface hesitation and development of steam hammers.

5. *Retain symmetry.* Whenever possible, part symmetry is held first about the vertical axis, and then about the horizontal axis. This procedure tends to balance out the internal contractive forces.

6. *Keep part bottoms at same level.* This will back-splash, for example, from a long piece onto a short piece, if the tops were at the same level. Finally, every part presents its own problem, which is solved by care-

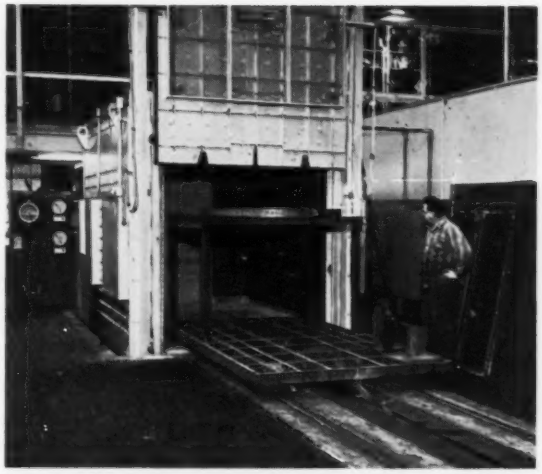


FIG. 2. Another type modern electric furnace which adequately serves in heat treating steel parts. Note temperature control devices on the left which insure that proper temperature is maintained for the specific process.

FIG. 3. Aluminum parts coming out of the salt solution used in heat treating. The next step will be the quenching tank.

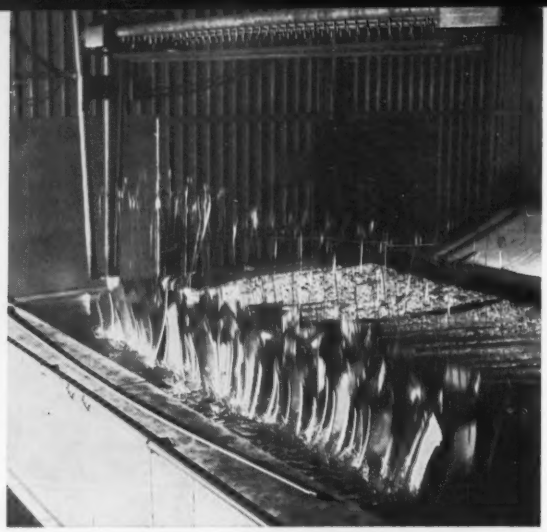
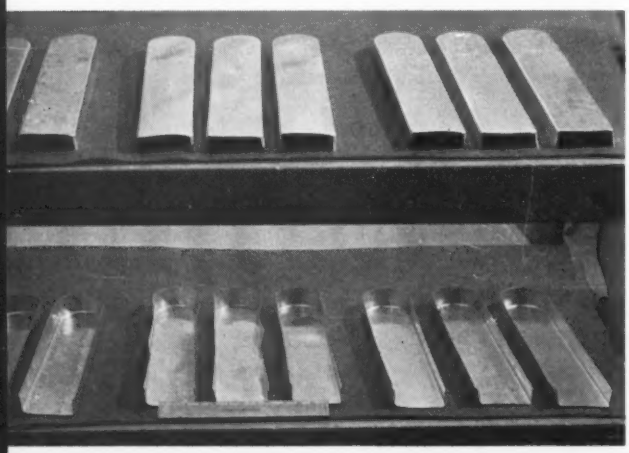


FIG. 4. Special racks for the free-fall method hold suspended parts during heat-treatment and release them into the quench. Martin engineers designed two racks for the purpose: one for one-at-a-time quenching of parts up to 14 ft. long, the other for simultaneous quenching of many small parts in an 8 ft. tank. In the loading position, hanger pins on the supporting pipe are held 20° F. above the horizontal by a pin through a counterweight at right angles to the pipe. When the trigger pin is removed, the counterweight rotates the pipe permitting the wire loop on which parts are suspended to slide off the pins, dropping the parts into the quench.

FIG. 5. Each group of three 75S aluminum pieces (both top and bottom) shows: (1) parts before quenching: (2) after basket quench requiring 8.67 min. handwork; and (3) after free-fall quench, requiring 3.6 min. handwork.



ful planning and consideration of the individual free-fall load.

Operation

Special racks are used for free-fall quenching to hold the suspended parts during heat treating and to release them into the quench. Martin designed two racks for this purpose; one is for one-at-a-time quenching of large parts up to 14 ft. in length, the other is used for simultaneously quenching many small parts in an 8 ft. quenching tank.

The single free-fall rack consists of a 2 in. by 14 ft. pipe containing the hanger pins. This is mounted on two ½ in. rods. At one end of the rack a pipe at right angles to the 14 ft. piece acts as a counterweight. In the loaded position the pins on the pipe are held at an angle of 20° F. above the horizontal by a pin through the counterweight. A 1 in. pipe rests against the hanger pins to prevent the wires from slipping off while the load is in the salt tank. When the trigger pin is removed, the pipe is rotated by the counterweight so that the hanger pins pass through an arc of 125° F. to a position 105° F. below the horizontal. This permits the wire loops on which the parts are suspended to slide off the pins and drop the parts into the quenching tank.

The multiple free-fall rack consists of 21 1 in. x 21 in. pipes which are pivoted within the frame. All of the pipes are linked off-center to a nine-pound centerweight which is held in position by a trigger latch. Hanger pin spacing is less on the multiple rack than on the single rack, although for dropping the load the operation of the pins is similar.

The recovery of small parts from the quenching tank is readily accomplished with the use of a basket submerged in the tank before parts are dropped. Large pieces may be retrieved by connecting a set of flexible wires to the parts. Another method is to place weighted ropes across the bottom of the tank so that the part may be lifted out by pulling on the free ends. Very small pieces, such as clips and handles, are placed loosely in a small basket wired to the free-fall rack.

Stainless steel wire (.090 in. diameter) is used for hanging parts on the racks because it is not appreciably affected by the corrosive action of the salt solution. However, since the majority of the pieces weigh less than 5 lb., aluminum or mild steel wire can be used. For heavy pieces multiple-wire attachment is required, and the wires are passed through tool holes drilled in excess stock or through special holding clamps.

When holes are drilled in sheet metal parts for the holding wires, the holes are no greater than ⅛ in. diameter and are placed near the center of a flange or web so that they clear, by at least four diameters, any fitting which may be attached during assembly of the part in the airframe. A minimum edge distance of two diameters should be maintained and the holes should clear any bend radius by at least 1/16 in. The hole should be so placed as to allow the part to hang in its best position when striking the water.

Economy

Two independent surveys, conducted one month apart, showed that 63 and 69% of the work in the handwork departments could be diverted to free-fall quenching. The actual proportion divertable is estimated to be between 60 and 70%.

A summary of the results of a time study of the reduction in handwork which results from the use of free-fall quenching is shown in table 2.

TABLE 2. Effect of Free-Fall Quenching on Handwork Time

Part Number	Photograph	Total Handwork Time Conventional (min.)	Free-Fall (min.)	Percent Savings
272B 6072392	Fig. 5	8.7	3.6	58
258E 8000063-11	Fig. 7	58.	38.	34
404-2000051-13	Fig. 6	31.	20.	35
40-7500091-1	—	16.	12.	25

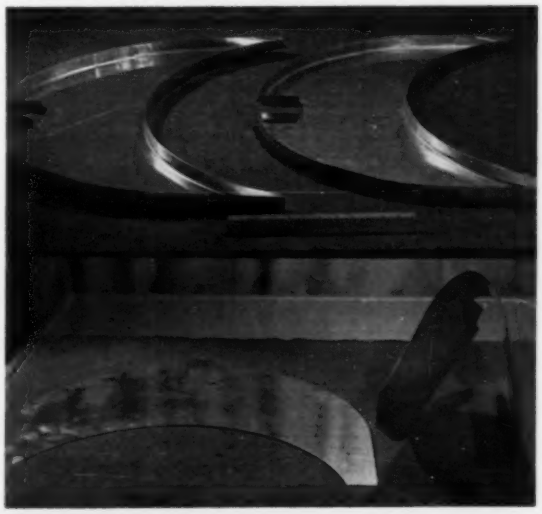
The four samples were selected as typical detail parts which are suitable for free-fall quenching. From these time studies, it is estimated that the average savings in handwork would be 40% to 10%. Such a saving more than counteracts the increase in loading time per piece required by the free-fall technique.

In the development of the free-fall technique the following additional advantages have been observed.

1. Less salt is removed from the molten nitrate bath by eliminating the use of the basket in the salt tank.
2. Rack distortion is eliminated and with salt baths, rack life is extended indefinitely.
3. Time delay to permit baskets to dry is totally eliminated.
4. Constant spring-back and easier forming is assured, since the material is formed in the SO condition.
5. The heating cycle (soaking time) is reduced by the elimination of the heat lost to the basket.
6. Refrigerated storage is sometimes unnecessary.
7. Surface discoloration is reduced.
8. Larger simultaneous quenching loads are possible.

FIG 6. A Basket-quenched piece 24S aluminum (left) requires 31 min. of handwork. The same piece, free-fall quenched (right), needs only 20 min. of handwork.

FIG. 7. The 24S aluminum sheet (lower left) may be formed in the SO condition and free-fall quenched to produce a piece (top left) requiring 38 min. total handwork; or it may be basket-quenched (lower right) and formed in the SW condition (top right) requiring 58 min. total handwork.



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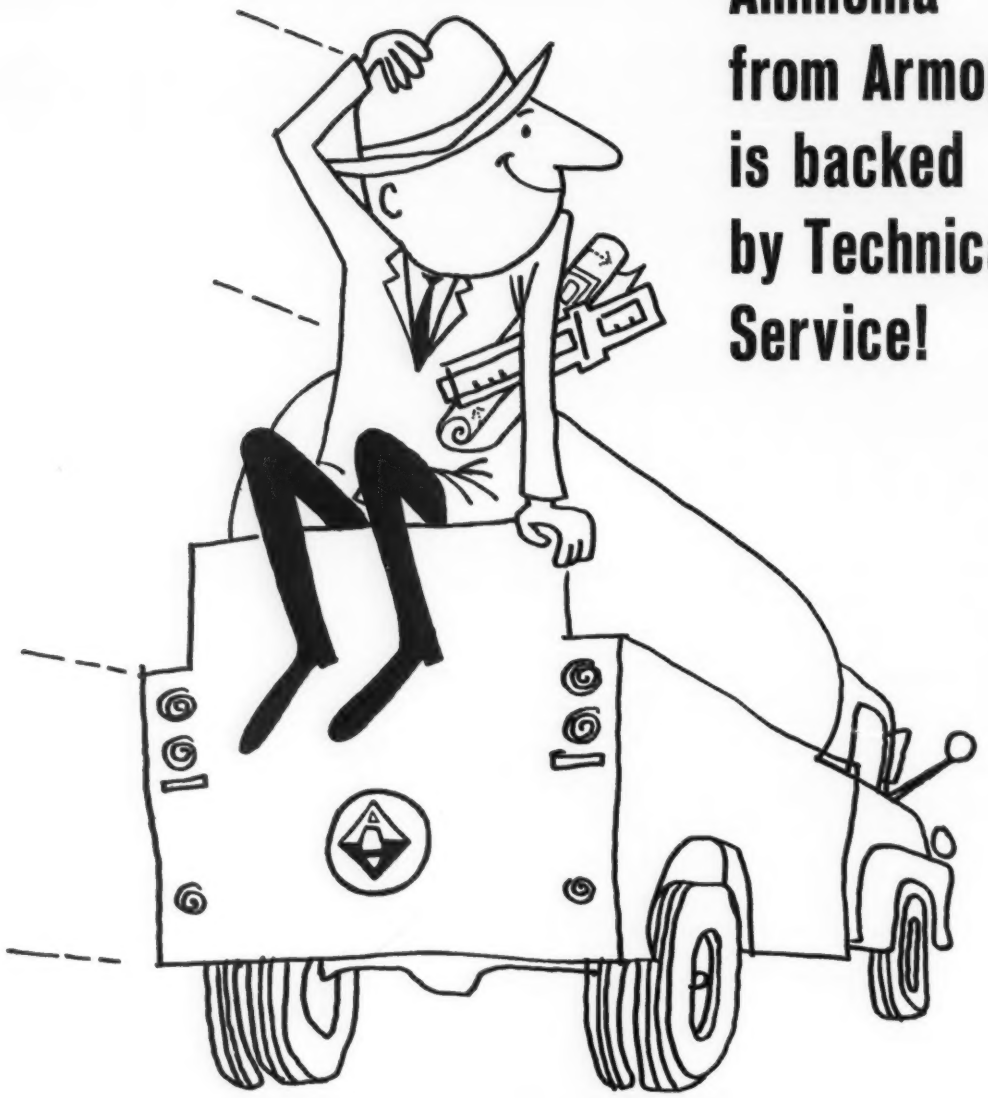

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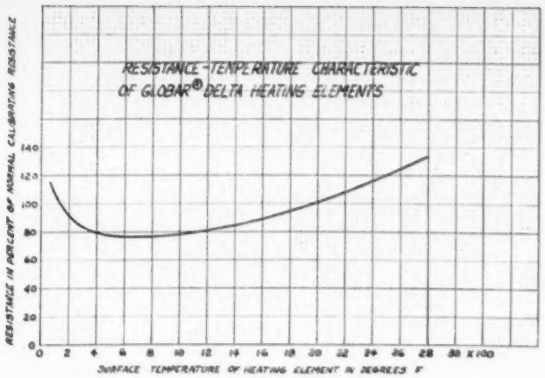

RESISTANCE-TEMPERATURE CHARACTERISTIC
OF GLOBAR® DELTA HEATING ELEMENTS
RESISTANCE IN PERCENT OF NORMAL CALIBRATING RESISTANCE
SURFACE TEMPERATURE OF HEATING ELEMENT IN DEGREES F

FIG. 1. Resistance-temperature characteristic of Globar Delta heating elements.

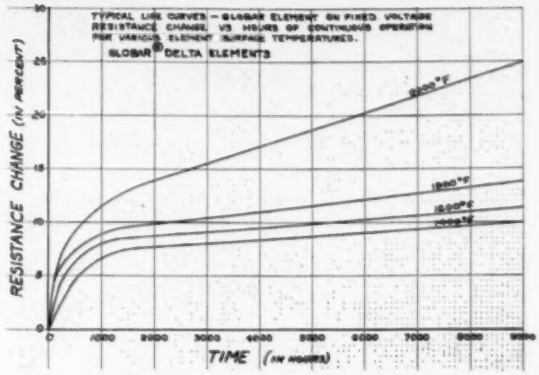

TYPICAL LIFE CURVES – GLOBAR ELEMENT ON FIXED VOLTAGE
RESISTANCE CHANGE VS HOURS OF CONTINUOUS OPERATION
FOR VARIOUS ELEMENT SURFACE TEMPERATURES.
GLOBAR® DELTA ELEMENTS
RESISTANCE CHANGE (IN PERCENT)
TIME (IN HOURS)

FIG. 2. Typical life curves of Globar Delta elements operated continuously in air on fixed voltages at various element surface temperatures.

SILICON CARBIDE HEATING ELEMENTS ARE USED ON-THE-LINE FOR HEAT TREATMENT

W. E. MACER

THE CARBORUNDUM COMPANY
REFRACTORIES DIVISION – GLOBAR PLANT
NIAGARA FALLS, NEW YORK

A new long-life silicon carbide heating element that increases in resistance at a slow uniform rate is now making on-the-line operation of electric furnaces feasible.

These elements are connected across-the-line, without transformers, for metal processing up to 2,000° F. Favorable operating requirements may permit even higher temperatures. Variations in temperature can be kept to a minimum by carefully engineering the installation. An automatic pyrometer and magnetic contactor will control the furnace over a wide range of temperature settings. Thus, transformer tap control is not required. Installation cost can be kept low.

Silicon carbide elements provide simplicity and versatility for heat treating operations. They can be easily and quickly replaced, without complete shutdown. Special refractory shapes are not required and consequently do not have to be removed or replaced when elements are changed.

Principles of Globar® Heat

Globar Delta elements are rods varying in size from 4 in. long by ¼ in. diameter to over 8 ft. long by 2⅛ in. diameter. They are made of self-bonded silicon carbide, the material once used almost exclusively to make grinding wheels, coated abrasives and refractories. This material makes a good heating element because it is an electrical conductor.

The center or heating section of the element is recrystallized Alpha (hexagonal crystals) silicon carbide having a resistance of approximately 0.1° per cm².

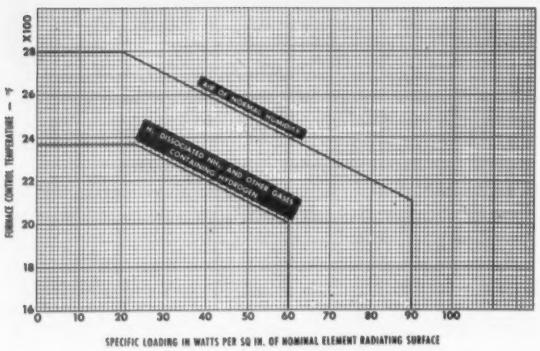


FIG. 3. Maximum watt loading of Globar Delta electric heating elements in relation to furnace chamber temperature.

The terminal ends of the element are Beta (cubical crystals) silicon carbide, and have a much lower resistance. The ratio of heat developed in a unit length of heating element to that developed in a unit length of terminal is approximately 25:1. As a result, the heat developed in the terminal ends is only a small portion of the total input. Extremities of the terminals are metallized with aluminum to provide low contact resistance.

These silicon carbide elements are much more refractory than most metallic heating elements, and may therefore be operated at higher specific watt loadings and temperatures to provide higher heat concentrations in a small space, providing greater furnace capacity.

Element Installation

Silicon carbide elements may be mounted vertically or horizontally if they are properly supported. In a typical horizontal installation, holes slightly larger than the diameter of the element are drilled straight through the furnace walls. The terminal portions of the elements are then laid flat in the bottom of these holes, so that the heating section spans the furnace chamber. The element terminals are supported by the furnace walls, allowing the element freedom to expand and contract.

The heating section should be 1 in. greater than the chamber span and each terminal hole should have a conical shaped recess at least ½ in. but not more than 1 in. deep. The heating section must be centered in the furnace chamber with no portion extending into the furnace wall beyond the conical recess.

Vertical installations are similar, except that the elements rest on adjustable mounting brackets. The elements are strong in compression but low in tensile strength. In this state they are susceptible to vibration and mechanical shock.

Elements may be connected in parallel, series, or combinations of the two. It is advisable to connect no more than two matched elements in series, although in a few cases it may be practical with on-the-line operation to connect three or four matched elements in series. When this is done, however, element life may be sacrificed and uniformity affected. A new element should never be connected in series with a used element.

To facilitate matching, the calibrating voltage is marked on the left end of the heating section and the measured current when the element is at a surface temperature of 1,960° F. on the right end. The actual resistance is determined from these values. The ampere rating is used to match new elements in series and in control groups. Elements of similar ampere rating have similar resistance values.

The input to heating elements connected on-the-line is controlled by the on-off method using an automatic pyrometer and magnetic contactor. An input controller can also be used. Selector switches in the contactor coil circuits permit selected pairs or groups of elements to remain on at all times, and the others to be on-off controlled by the pyrometer.

In another variation of on-the-line operation, the input to a periodic kiln can be varied by switches connecting the heating elements in series and parallel combinations.

Because it is impossible to make general recommendations on all types of heating and processing equipment, each proposed installation should be engineered for maximum efficiency and economy.

Operating Characteristics

Element resistance varies with surface temperature. When a furnace is started up, the resistance drops until the element surface temperature reaches about 800° F. within two to five minutes after the circuit is closed, then starts to rise as shown in Fig. 1. The nominal resistance value of an element is based on a surface temperature of 1,960° F., and the manufacturing resistance tolerance is ± 10%. This tolerance and also the actual line voltage and any line fluctuations should be considered when calculating power input.

All silicon carbide heating elements increase in resistance with use. Hence when engineering a Globar equipped installation to be operated directly off a 115 or 230 volt line or any fixed voltage, the rate of increase in resistance must be considered. Usually 25% to 50% over-power should be provided, although this depends on actual conditions. If enough elements are installed so that the initial input to the furnace at operating temperature with new elements is 50% more than is required, it will be possible to obtain service from the elements until their resistance has increased 50%. Unless the elements can be reconnected, this would be the length of time they might be operated with on-off control at the original applied voltage. Figure 2 shows the resistance change of typical elements operating at various temperatures. The electrical loading for on-the-line or fixed voltage operation is the same as for any other type of control. In this

operation the element combinations must have a resistance high enough to limit the loading to recommended values for the temperature and atmosphere involved. Figure 3 shows the maximum watts per square inch of radiating surface, for operation at various temperatures and in different atmospheres.

Application Experiences

Electric Wire Company, North Hampton, Massachusetts has two annealing furnaces in operation utilizing 32 Globar elements across a 220 volt line. The firm has plans for two additional installations. This company manufactures about 42 different alloys from monel, nickel, Inconel, stainless steel, etc., from which they draw small diameter wires. In other furnaces they handle additional alloys formed from gold, silver, phosphor bronzes, and brasses.

The first furnace, built approximately 18 months ago, still uses the original Globar elements. The furnaces normally operate in the 2,000° to 2,250° F. range, occasionally around 1,800° F., and the temperature reportedly remains uniform. The furnaces are kept hot continuously.

Wire passes through the furnaces in Inconel tubes containing a cracked ammonia atmosphere. Production of stainless steel wire is approximately 6,000 lb. daily. After 18 months' service, resistance increase has been so slight that output has not been affected.

A Canadian affiliate, Central Electric Wire Company, Ltd., Perth, Ontario, operates two furnaces of the same design for heating most of the alloys mentioned.

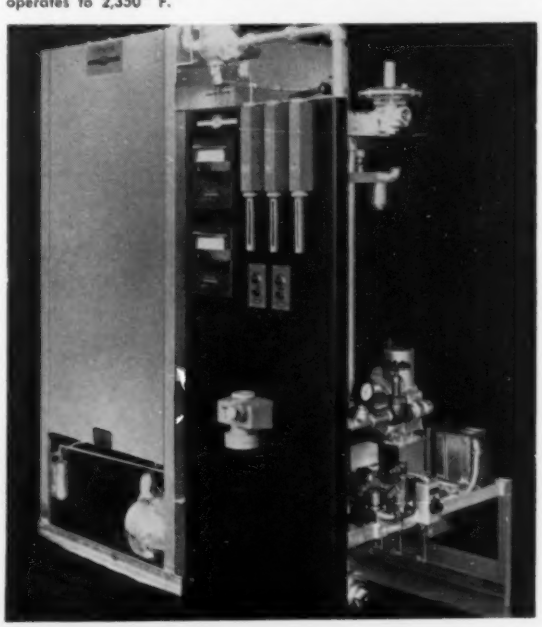
In their metallurgy furnaces, The Sentry Company, Foxboro, Massachusetts, uses silicon carbide elements across-the-line exclusively, obtaining clean, rapid, uniform heating and temperature flexibility. Furnaces are designed with ample kilowatt rating to prolong the useful life of elements. Sentry furnaces are used extensively by metal processors for a variety of applications. Grobet File Company, Inc., for example, uses three furnaces to heat-treat their rotary and chisel cut files. Heat treatment is particularly critical here because the cutting edges and flutes of the files are formed by impact and must be protected during hardening. Hamilton Watch Company uses two furnaces for experimental work on high speed steel alloys, and for production heat treating of miniature form cutters, reamers and very small drills. Taft-Pierce Manufacturing Company uses Sentry furnaces for its own high speed heat treating as well as for outside contract work.

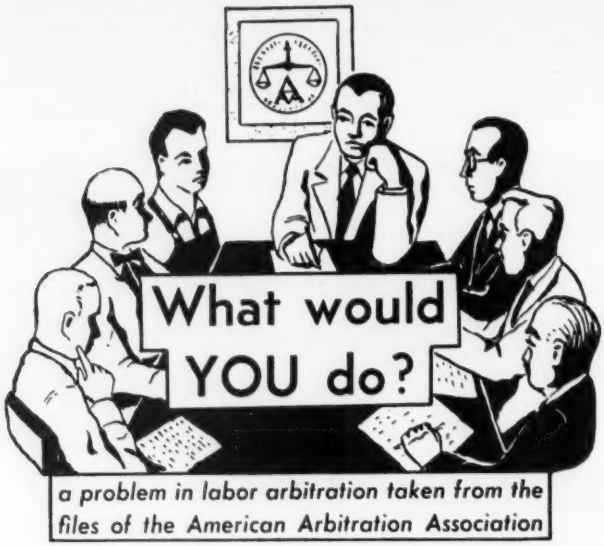
The "IGL" generator developed by C. I. Hayes, Inc., Cranston, R. I., equipped with silicon carbide elements installed across-the-line provides atmospheres for decarb-free treatment of special steels, carbonitriding of mild steels and controlled atmosphere sintering. This unit operates to 2,350° F. The elements, operating in air, cannot collect scale and create a shorting hazard.

Concluded on page 37

FIG. 4. 32 Globar elements installed across-the-line provide heat (2,200° F.-2,250° F) for annealing small diameter wire produced from monel, Inconel and stainless steel alloys. The wire passes through the electric furnace in Inconel tubes filled with a cracked ammonia atmosphere.

FIG. 5. An "IGL" generator built by C. I. Hayes, Inc., Cranston, R. I., is equipped with silicon carbide elements connected on-the-line. It operates to 2,350° F.





CASE OF THE HANDY ENGINEER

One Wednesday a methods engineer in an engine building plant notified the general foreman that he was coming in the following Saturday to experiment with an idea he had for a different layout of the assembly line and that it would be necessary to move certain shelves and racks to another location. Since the union contract barred employees outside the bargaining unit from doing that kind of work, the engineer assumed that a maintenance man would be assigned to it.

Wednesday, Thursday and Friday went by and nothing was done. The engineer assumed a maintenance man was coming in to help him Saturday, on overtime, but that didn't happen either. So the engineer rearranged the shelves and racks himself and then went on with his experiment.

When the union found out about it on Monday morning, a grievance was promptly filed. "The collective bargaining agreement does not permit engineers to do bargaining unit work," the steward reminded management. "You should have asked a maintenance man to come in on Saturday. As a remedy, we are asking four hours' pay at time-and-a-half for the senior maintenance man, because that's the least he would have earned if he had been asked to work on Saturday."

The personnel manager admitted that a slip-up had occurred, but denied the grievance on two grounds: (1) The situation on Saturday was an "emergency," since the engineer couldn't work without the re-arrangement of shelves; and (2) In any case, the work he did was *de minimis* and the grievance should not be upheld on trifles.

What Would YOU Do?

THE AWARD: The arbitrator said the situation on Saturday couldn't be considered an emergency, since management had more than enough time to cope with it on a non-emergency basis. "Although the engineer worked less than an hour," he said, "the issue was a serious one for the union." For that reason, he rejected the argument that the violation was "trifling." While the union won the case, the remedy he granted was not exactly what was asked. The arbitrator said the company could have assigned a maintenance man to the work without requiring him to come in on Saturday. One hour of overtime during the week would have done the trick. He therefore awarded one hour's pay at time and a half to the senior maintenance man.

From a small furnace to a tall furnace Hevi-Duty helps you find the value solution to your heat treating problems

Each of the Hevi-Duty furnaces shown below delivers the value solution to a heat treating problem—the solution combining comprehensive design and industrial engineering with soundly built and tested equipment—the solution that pays off in increased production and extended economic life of equipment.

In each case, Hevi-Duty drew from its experience in solving thousands of industrial heat processing problems for all types of applications.

In each case, Hevi-Duty offered equipment from industry's most complete line of electric and fuel-fired furnaces and ovens. (Where stock designs or adaptions won't do, Hevi-Duty custom-engineers equipment—from laboratory furnaces to huge field-assembled furnaces.)

Case histories by the hundreds testify that it makes profitable sense to call in your Hevi-Duty sales engineer to help find the value solution to your heat treating problems.

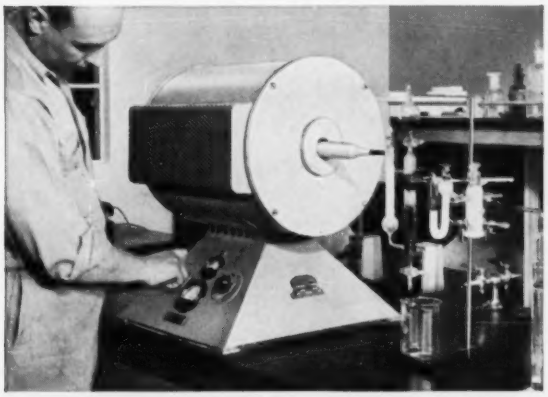
HEVI-DUTY

Electric and Fuel-Fired Industrial Furnaces and Ovens

B P C

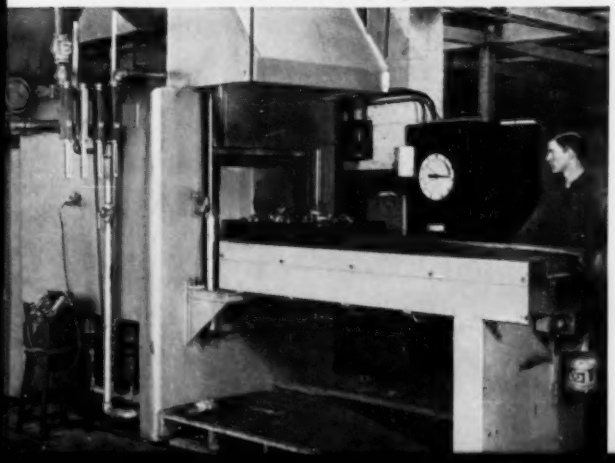
A Division of Basic Products Corporation

Hevi-Duty Electric Company, Milwaukee 1, Wis.

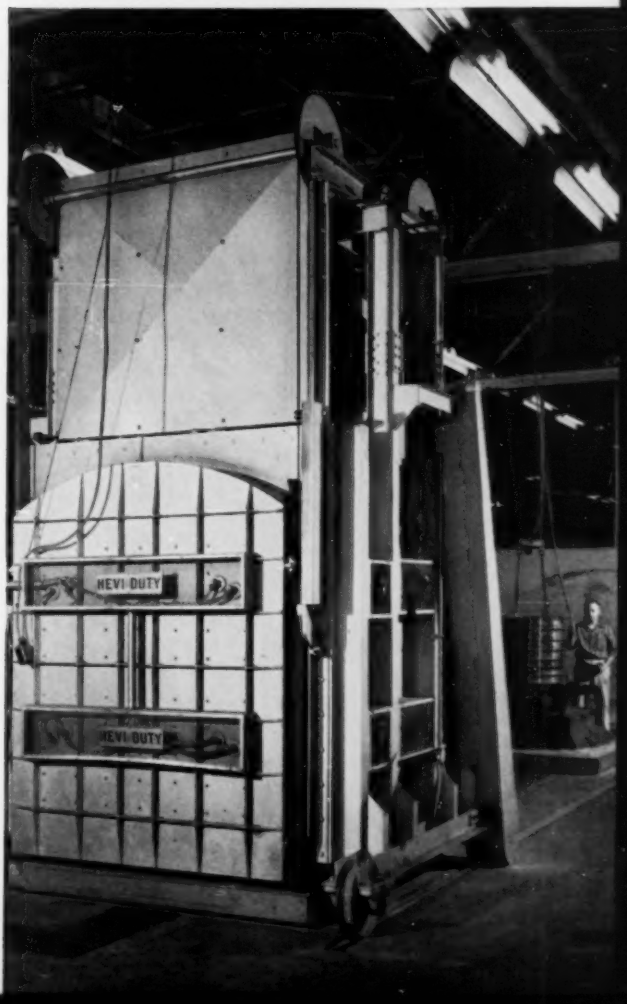


▲ *Merit Corp., Milwaukee, Wis., uses a Hevi-Duty tube furnace to maintain precise temperatures in laboratory quality tests on briquettes used by foundries as an additive to gray iron melts. Two-stage combustion operation on crushed sample burns off free carbon at 1679°F, total carbon at 2471°F.* **For more complete information, please write for Bulletin 254.**

Superior Metal Treating Corp., Muncie, Ind., uses two Hevi-Duty automatic Clean-Line furnaces 24 hours a day, 5 days a week for carburizing, carbonitriding and bright hardening. Temperatures range to 1925°F. The load-transfer mechanism is outside the heating chamber, reducing equipment maintenance. **For more data, request Bulletin D-100.** ▼



This Hevi-Duty traveling, double-end, box furnace provides ±10°F control at temperatures to 1850°F for bright tempering and stress relieving stainless steel jet engine weldments. This furnace is in continuous operation. User reports brightness improves during process. Unit provides bell-furnace mobility despite lack of head room. **Please write for Bulletin 653.** ▼



PART: Welded bellows-type seal. **MATERIAL:** Type 410 Stainless Steel. **SPECIFICATIONS:** To be hardened under close control because of variations in metal sections. Finished assembly to be clean, bright and free from oxides and scale. Seal in photo has been cut to show cross section of the bellows-type seal.

How would you heat treat a part like this?

The stainless steel bellows-type seal shown is used in a number of applications, from refrigerating systems to missiles, where mechanical seals are needed to resist extreme temperatures from —400F to +1200F. Heat treatment is complicated by the wide variation in section between the thin bellows and the much heavier outer rings.

The Sealol Corporation, Warwick, R. I., solves the problem with a Hayes electric furnace equipped with GLOBAR® silicon carbide heating elements. Depending on the material of the welded bellows (stainless steels of the 300 and 400 groups, precipitation hardened steels such as AM350, 17-7PH, Inconel X, etc.), hardening is between 1700F and 1900F, followed by muffle cooling, both in a hydrogen atmosphere.

GLOBAR elements make possible the precise temperature control and clean heat, independent of the atmosphere, required in this critical operation. Rod-type element simplifies design, furnace construction and servicing. Losses are minimized because all heat is produced and contained inside the furnace.

The many advantages of heating with GLOBAR elements often more than cancel out differentials in BTU costs between electricity and other fuels. Why not investigate with your furnace builder—or write to Refractories Division, Globar Plant, Dept. MT-40, The Carborundum Co., Niagara Falls, N. Y.

For latest advances in silicon carbide heating elements . . . count on

CARBORUNDUM®

For precise, economical electric heating

GLOBAR silicon carbide heating elements

- Shipped from stock or within two weeks.
- Temperatures from 1400 to 2800 F, precisely controlled, independent of atmosphere.
- Easily replaced from outside without waiting for furnace to cool.
- "On line" operation for many applications—no transformer necessary.
- Rods 4" to 105" in length.
- For greater economy in heat treating, brazing, forging, melting, and sintering.

HEAT-TREATING HINTS

SPECIAL HEAT-TREAT TECHNIQUES: SOME CASE HISTORIES

JULIUS TURK
Paulo Products Co.
St. Louis, Missouri

THE heat-treating of tools, dies or other manufactured working units often presents unusual and different—out of the ordinary—processing situations to the commercial heat-treater. Considering that the tool designer can reference numerous types of steels from some six major groups, or that the product designer also has innumerable classes of structural steels at his discretion, it is not unreasonable to consider that the heat-treater can possibly inherit a proverbial "furnace full" of processing problems.

Such problems become even more acute when the heat-treatment is considered only as a projected means of producing certain physical characteristics with no consideration ever applied to the other equally important factors of proper material, tool design, tool use, processing-handling conditions, and dimensional stability. This last factor alone often develops into the most important element in the processing of a tool.

Consequently the heat-treater frequently is asked to arrive at a desired set of conditions including an adherence to dimensional stability that quite often is beyond or out of a feasible range for the particular material involved. Lack of communication between the designer, steel manufacturer and heat-treater can frequently be disastrous and then, unfortunately, at the very end of the processing line. This type of communication has been steadily improving. With numerous heat-treat approaches available and by use of proper equipment, the heat-treater can usually arrive at some satisfactory end result.

As examples of requirements necessitating some sort of special techniques and control, consider the following cases: Figures 1, 2 and 3 indicate plastic cup-mold dies, approximately 20 lbs. each, positioned with a special manifold-type carburizing fixture used during the heat-treat (hardening) cycle. These particular dies produce a plastic demitasse cup manufactured as a premium item. The dies were required to produce a total of some 5,000,000 units at a rate of 200,000 per month. To maintain production schedules most economically it was necessary to hold maintenance or breakdown time losses to a minimum for at least a one-year run. To produce this item most economically by maintaining a constant material usage of the expensive plastic raw material, the tool steel had to be capable of adhering to rigid stability, uniformity of properties and size change during and after heat-treatment. It is understood that a variance as small as several thousandths of an inch between different die sets would result in units being produced with heavier wall sections, requiring the use of considerably more material to produce the same number of units. Whereas the increase per unit

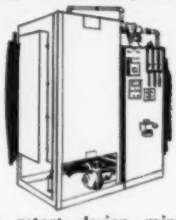
Continued on page 16

EDWARD F. GRADY
Atmosphere Equipment
Specialist, reports . . .

GAS GENERATOR ON LINE OVER 9000 HOURS WITHOUT ELEMENT CHANGE

C. I. Hayes Type IGL-1004 Endothermic Gas Generator installed at a nationally-known mold die firm* has been operating at 1850°F on a steady cracking process for over 9000 hours without change of heating elements. Why such outstanding performance?

Rugged Construction and Good Design provide extra life insurance. A new Hayes retort assures maximum utilization of catalyst. Straight-



through retort design minimizes downtime due to catalyst change. On this installation, catalyst was changed in less than 3 hours. Original catalyst lasted 4800 hours . . . even better service is expected of the recharge.

New Delta Globar® Elements — having practically constant resistance — add extra months of service life. Elements can be connected directly across the line . . . need no tap transformers . . . are easily replaced without shutting down the generator. Here's real economy!

Wide-Range Flexibility and Precise Control are the mark of the Hayes IGL-1004. This "endo" generator can supply low *or* high carbon-potential atmospheres for jobs like copper brazing, annealing of steel, sintering of iron compacts, carbonitriding, etc. Wide span heating provides reserve capacity. Flexibility of temperature range — especially at higher ranges — can be utilized to the maximum . . . for maximum output at lowest dew-points without fear of burn-out.

Bulletin 580BA gives all facts on IGL-1004. Write for your copy today.

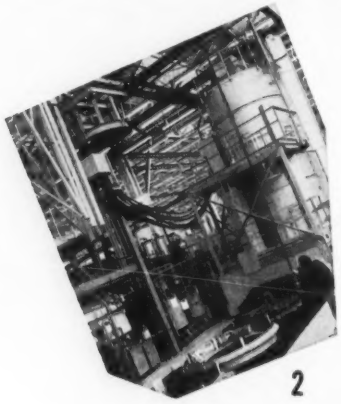
*Name of installation on request

C. I. HAYES, INC.
Established 1905
816 WELLINGTON AVE. • CRANSTON 10, R. I.

It pays to see HAYES for metallurgical guidance, lab facilities, furnaces, atmos. generators, gas and liquid dryers.

INVERTED PIT FURNACES

Company (listed according to furnace size)	Heating Space Diameter	Heating Space Length	Description	No. of Furnaces	Source of Heat	Types of Atmospheres	Maximum Temperature
General Electric Company Rocket Engine Section Cincinnati, Ohio	120"	30'	Bottom Opening Gantry	1	Electric	Endothermic	2000
The Marquardt Corp. Ogden, Utah	80"	10'	Bottom Opening	1	Electric	Endothermic and Exothermic	2000
Douglas Aircraft Company, Inc. Torrance, California	74"	18'	Bottom Opening Gantry	1	Electric	Endothermic and Exothermic	2000
Lockheed Aircraft Corporation Burbank, California	60"	15'	Bottom Opening Gantry	1	Electric	Exothermic	2050
J. W. Rex Company Lansdale, Pennsylvania	60"	15'	Bottom Opening Gantry	1	Electric	Endothermic	1950
H. K. Porter Company, Inc. Ambridge, Pennsylvania	48" 36"	13' 18'	Bottom Opening Gantry	2	Gas	Endothermic	1700



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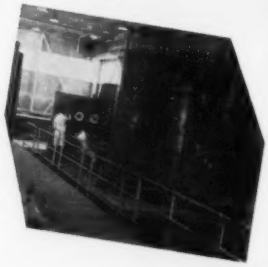
1. J. W. REX CO.
2. LOCKHEED AIRCRAFT CO.
3. H. K. PORTER CO.
4. GRISCOM-RUSSELL CO.
5. DOUGLAS AIRCRAFT CO.
6. MARQUARDT CORP.
7. GENERAL ELECTRIC CO.



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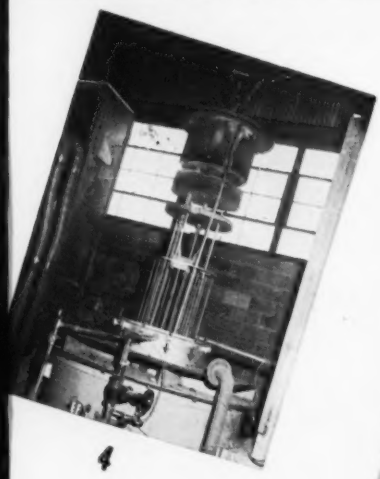
PIT FURNACES (TOP OPENING)

The National Acme Company Cleveland, Ohio	30" 30"	7' 8" 6' 8"	Pit	2	Electric	Endothermic	1900
Griscom-Russell Company Massillon, Ohio	26"	22'	Pit	1	Gas	Exothermic, Nitrogen, Helium, Hydrogen	2100

Tempering Facilities		Metallurgical Facilities
Size (Vertical)	Temperature °F	Magnaflux, X-Ray, Tensile and Hardness Testing
120"x30'	1400	All plus environmental test, stress and static test, ultrasonic inspection, and process development laboratories.
80"x10'	1000	Magnaflux, X-ray, tensile and hardness testing plus Spectographic, Diffraction Unit (G.E.xRD5), Impact Tester, Krauss Axial Fatigue, etc.
74"x18'	1300 1250	All
60"x15'	1450	All plus ultrasonic, spectograph, stress and static test, and process development laboratories.
71"x15' (1) 60"x13' (1)	1500 1500	All except X-ray
60"x51"x12'6" 36"x13' 48"x18'	850 1700 1700	All plus ultrasonic and magnaglo, stress and static test.
30"x7'8" 30"x6'8"	800	All (except X-ray) plus magnaglo.
26"x22'	Furnace cooling or air cooling	All plus ultrasonic testing, helium mass spectrometer testing, die penetrant testing.

Survey Of Special Furnaces For Rocket, Missile, And Aircraft Components



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In the September-October issue of *Metal Treating* we published a comprehensive survey of the type of equipment being used for the heat treatment of rocket, missile, and aircraft parts. The information was received as a result of directing requests for specific information to the known manufacturers and processors of components of this type. Since the publication of this review additional information has been furnished and further details concerning work in progress on such equipment at the time of publication have been secured. These new facts are presented for the benefit of our readers.

Information for this survey was furnished by the following companies:

Douglas Aircraft Company, Inc.
General Electric Company
Griscom-Russell Company
Lockheed Aircraft Corporation
Marquardt Corporation
National Acme Company
H. K. Porter Company, Inc.
J. W. Rex Company

weight is small, the overall weight factor of a great number of units is considerable.

To obtain these special properties, a general-purpose, air-hardening type tool steel was selected. This material indicated a satisfactory combination of properties relative to hardenability, strength and shock-resistance, minimum distortion in heat-treatment, machinability and hot-work properties. Being a true compression-mold type and operating at 3,000 p.s.i. on the inside of the die cavity, it was desired to maintain zero movement of the cavity, if possible, especially at the approximate 330° F. temperature on the operating surface.

Previous experience with this type of die emphasized the importance of establishing and compensating for growth and movement factors. For example, a growth condition had been noted in some instances at the operating temperatures although the heat-treat tempering temperature was above the operating surface heat of the cavity face. This might be attributed to the effect of untransformed microstructures induced by the heat-treatment or retained austenite—which later transforms to a type of structure of greater volume. To eliminate or minimize such effects by obtaining more complete structural transformation, a deep-freeze operation was introduced between tempers. To support the factors for still improved dimensional stability, a sub-critical anneal or stress relief heat-treatment after rough machining was found desirable. The critical nature of the stability requirements made it mandatory that the annealed stock itself be as consistent as possible in this condition.

It was also noted that galling effects between the core pin and core pin hole were not uncommon. Apparently the variable section size and mass involved induced slightly

Continued on page 17

. . . . tough on retorts

2100° F VACUUM BRAZING

demands Exacting Fabrication

This 8-foot-high bell retort fabricated of ¼-in. RA 330 stainless by Alloy Engineering is used for equalized vacuum brazing in an electric refractory furnace. Designed for 2100° service at a 4 micron/1000 micron equalized vacuum, the retort is subject to cyclic thermal stresses reflected by a 1-in. increase in diameter at operating temperature.

The upper cylinder, 4 feet in diameter, tapers to 6½ feet at the bell base where it is joined to the 1¾-in. mild-steel base ring grooved top and bottom for O-ring vacuum seals.

Alloy's experience with performance factors of high temperature equipment enables it to assist in engineering with recommendations as to construction, type and gauge of material. Careful fabrication, preparation and welding enables Alloy to produce retorts, muffles, and fixtures for trouble-free high-temperature service.

Rely on Alloy's experience and facilities to help solve your heat treating problems.

Write today!

continuous carburizing furnace BASKET

Designed by Alloy or fabricated to your specs.; trays and fixtures for economical service.

2100° hydrogen atmosphere sintering MUFFLE

Custom engineered and fabricated to your service needs.

THE **ALLOY** ENGINEERING COMPANY

70 Sheldon Road / Berea, Ohio

HEAT TREATING HINTS

lower hardenability properties in the core pin holes—creating galling with the harder pins.

These experiences were incorporated into the heat-treatment of the subject dies, the one unique addition being the introducing of greater wear-resistant faces, especially in the core pin holes.

To accomplish this, a manifold-type fixture with perforated feeder tubes was constructed, one end being sealed and the other end assembled with a pipe fitting. The unit was packed with a carburizing compound and sealed. Each feeder tube was inserted through the core pin hole of the die. On heating for the hardening cycle, the emitted carbonaceous gases permeated the inner areas of the holes, actually inducing a carburizing effect at these surfaces and greater surface hardenability.

During the process, a very slight carburizing atmosphere was employed with the dew point maintained to prevent an excessively high carbon potential, a condition favorable to soft skins caused by the previously noted retained austenite effect. Because of the variable masses in the dies, a 30 second oil quench, instead of a straight air cool, was used. This enabled the heavier die sections to be critically cooled for maximum hardenability without any noticeable additional distortion. To obtain full advantage of continued critical cooling, a blast of air was directed through each core pin hole after the interrupted oil quench. During the cooling-down cycle, each die was also positioned and turned as required to maintain full flatness.

The special handling and care employed in the processing of this type of plastic-mold die resulted in the desired additional wear properties as well as dimensional stability held to a total out-of-roundness of approximately 0.002 in.

Figures 4 and 5 indicate an aluminum die casting die positioned in a 50 ton straightening press. Made from a 5% chrome air-hardening steel and pack-hardened and tempered to a Rockwell C46 to C48, the die exhibited a somewhat unusual material movement after heat treatment. This problem was therefore primarily one of dimensional stability. Being approximately 11 by 13 by 2 in. in overall dimensions and weighing 60 pounds, the die was stress-relieved after rough-machining and the cavity then finish-machined and ground. The cavity had to be held to as close to a zero movement as possible. After heat treatment, the cavity was found to have maintained edge-and-side parallelism but two sides indicated an out-of-square condition of approximately 0.010 in.

There appeared to be an actual condition of parallel slip of two sides. This type of movement is not particularly normal, relative to the growth, shrinkage or bowing effects being usually encountered. In order to recover as much of this movement as possible, a direct vertical load was first applied after

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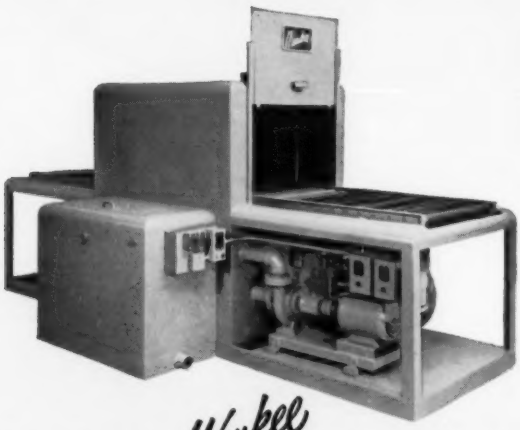


There's a standard Waukee® WASHER
TO MATCH YOUR CARBONITRIDER OR CARBURIZER!

Whatever the size of your carbonitrider or carburizer, the new Waukee Washer has a standard size to match it. Size range: 24 x 36 x 18 — 24 x 48 x 24 — 30 x 48 x 24 — 36 x 48 x 24.

COMPLETE — NO "EXTRAS" — Waukee parts washers come to you complete, ready to locate, connect to utilities, and begin operation. No "extras" to buy and install. Pumps, burners, controls are designed as integral parts of the Waukee Washer. You use your present furnace work-baskets, too.

FLEXIBILITY — You gain in flexibility with Waukee Washers. Standard units are available in "in-and-out" feed or straight-through, conveyor type, and in one, two, or three stages with rinse and dry. High-efficiency with gas, electricity, or steam.

THOROUGH CLEANING — The smallest Waukee Washer sprays a minimum of *one ton of hot detergent solution through the load each minute*. Solution penetrates work basket from top and bottom, washes away oil and foreign matter from the densest charge. Bull's-eye timer cycles the load for complete washing without guesswork or waste of time.

Complete data in Bulletin 1201 — write for it today.

Waukee-washed parts are free of cutting and quenching oils, mean clean furnace atmospheres, therefore predictable case depths and cleaner, brighter work.

Waukee ENGINEERING CO.

5137 N. 35TH ST., MILWAUKEE 9, WIS.

MAKERS OF WAUKEE GAS FLO-METERS • MIXORS • COMPRESSORS

AGF HEAT TREATING PRODUCTION LINE AT HOLO-KROME INSURES UNIFORM TENSILE STRENGTH

HOLO-KROME features socket screw products having toughness as well as uniformity of hardness and strength. AGF Furnace equipment contributes to this high standard.

POSITIVE ASSURANCE that every Holo-Krome socket screw will have correct tensile strength and a uniform distinguishing color, characteristic of quality heat treating, is embodied in the above AGF installation.

This AUTOMATIC production line consists of:

(1) An AGF No. 240 Heating Machine which hardens the screws in a controlled atmosphere at the rate of 400 to 500 pounds per hour.

(2) An AGF Conveyorized Quenching Tank.

(3) An AGF No. 242 Heating Machine which tempers the work utilizing residual quenching oil remaining on the work pieces to produce an attractive black finish, which then discharges into

(4) an AGF Conveyorized Quench Tank equipped with a vibrator discharge chute for removing the oil and carrying the work to the packaging operation.

Your heat treating of fasteners or other small parts like stampings, screw machine products and precision castings can be accomplished with greater uniformity and quality control and at lower cost in AGF equipment.

PIONEER Furnace Engineers and experienced metallurgists at AGF will weigh your needs and make a proper recommendation without obligation.

Write today for the name of nearest AGF factory trained representative located in major industrial areas.

Visit AGF at the METAL SHOW
Booth No. 726

AMERICAN GAS FURNACE CO.

808 LAFAYETTE STREET — ELIZABETH 4, N. J.

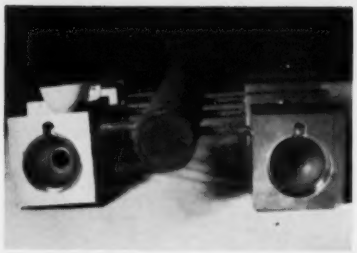


FIG. 1. Sealed front end view of manifold fixture with feeder tubes inserted through core pin holes of dies. Note sample cup produced by this type of die.

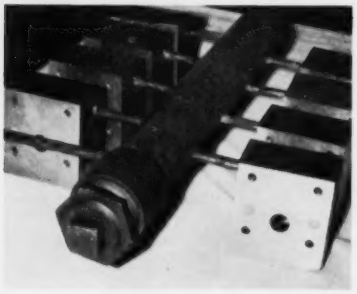


FIG. 2. Backend view of manifold fixture with fitted plug. Carburizing compound was packed through this end and sealed with threaded pipe plug.

FIG. 3. Side view of manifold fixture and feeder tubes in dies. Note in lower front die how feeder tube is inserted completely through core pin hole. Extra tube was for test sample subjected to analysis and microscopic examination.

positioning and clamping the die (heated to approximately 700° F.) in an offset, horizontal position in a 10 ton press. When no movement at this degree of loading was noted, the die was then heated to 900° F. and positioned as shown by a vertical load application to the angular position of the die. It was considered that any shifting would be consistent in direction of the two out-of-square sides — the movement equalizing one side against the other. A load of 90,000 pounds indicated some such movement, but the die recovered after cooling. The die was then heated to the original draw temperature of 1,100° F., and a load of 100,000 pounds applied, shifting the out-of-square sides approximately 0.010 in. past the equal center; on cooling, the die recovered approximately 0.006 in., considered a satisfactory degree of salvage.

The examples concerned techniques introduced to achieve a specified set of conditions or properties, an improvement of wear characteristics, a critical dimensional problem, or a situation involving both such conditions. The choice of correct tool material and proper design based on intended application will minimize or even possibly eliminate many problems induced by the heat-treating cycle.

Consider now what is becoming a matter of increasing quality control in the commercial heat-treat shop—that of processing the high-strength aircraft materials. The demands for exacting properties necessitate similar exacting processing controls. Some such demands leave little or no room for deviation from certain specified standards wherein examinations have indicated possible initiation of fatigue failures under high stress applications by only slight variances from such standards.

Figure 6 exhibits a raw and a finish-machined forging of a wing-hinge fitting of a jet aircraft. The specified mechanical properties and heat-treat controls are perhaps some of the most exacting yet noted. Fabricated from a forging of modified 4330 steel, the fitting is heat-treated to 220,000 to 240,000 p.s.i. Control is actually initiated by the forger, the material meeting specified chemical and grain flow properties, grain size, hardenability, and impact properties. Weighing approximately 100 pounds in the as-forged and annealed condition, the fitting is completely machined before heat-treatment and polished after heat-treatment. Dimensional factors of ± 0.005 to 0.010 in. are closely maintained.

For dimensional stability during heat-treatment, the fitting is subjected to a martempering operation. Processed from a salt bath, a test tab from each fitting is examined for decarburization effects

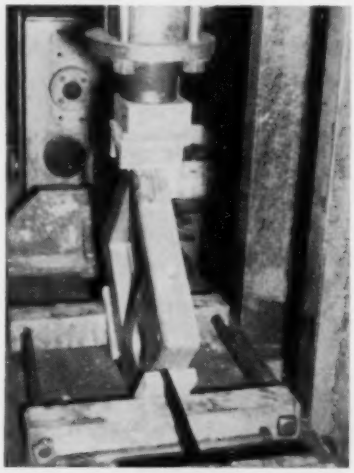


FIG. 4. View of die positioned in 50 ton straightening press. Note angle of load application and method of supporting die.

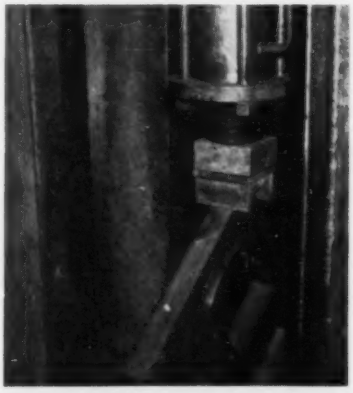


FIG. 5. Close-up view of "out-of-square" cavity area. Load is applied at corner area to shift parallel sides of cavity.

of salt bath irregularities. Microscopic examination for such effects will not alone necessarily detect such conditions, especially if the effects are only of a partial diffusion type. Therefore, actual microhardness tests are traversed from the edge of the test tab at 0.002, 0.004, 0.060 in., and in the core area. The values cannot vary more than two Rockwell 30N

Continued on page 21

Pacific

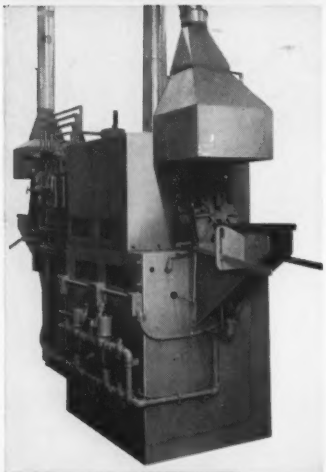
BRAZING FURNACES

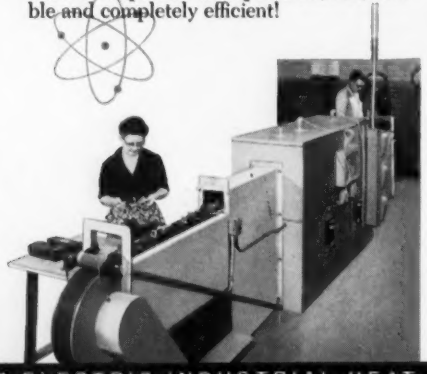
are specifically DESIGNED to meet the *critical* requirements of

ELECTRONIC MANUFACTURERS

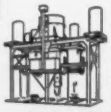
The close tolerances demanded today in the design and manufacture of electronic parts in order to make them smaller and more heat resistant – have called for new concepts in furnace design. Faster handling methods, automatic controls and consistently even heats—have required the design and construction of a wide variety of furnaces to meet the varied and special needs of the electronics industry.

In every installation, Pacific Scientific Furnaces have proved to be practical, fast, flexible and completely efficient!

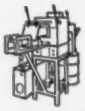




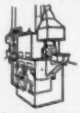
BOX TYPE BRAZING used for medium temperature brazing up to 2100°F. Movable loading rack at front of furnace aligns with furnace hearth during loading and automatically retracts, clearing area for door to close. Has integral atmosphere-tight water-jacketed cooling chamber.



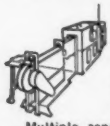
DOUBLE ELEVATOR – for brazing Klystron tubes. In this two station, one furnace system, hydraulic rams alternately raise and lower work into brazing retort and through water-jacketed cooling chamber. Furnace temperatures maintained by multiple zone control system.



FULL RETORT DU-AL – for laboratory and research use. Also excellent as production unit. Design includes separated purge, heating and water-jacketed cooling chambers. Full alloy muffle with no exposed brickwork allows use of extremely high purity atmosphere.



HEATED TUBE provides rapid heating by utilizing retort as heating element. Goes from ambient to 2200°F. in 12 minutes! Water-jacketed cooling chamber located at discharge for fast cooling cycles. No exposed brickwork allows use of inert or reducing atmospheres.



CONVEYOR BRAZING shown here being loaded with wave guide assemblies for silver alloy brazing. Design provides for preheating of parts prior to entering brazing chamber. Multiple zone control for precise temperatures. Suitable for use with atmosphere.

WHATEVER your heat-treating needs – or production requirements – a Pacific field engineer will be glad to discuss it with you. Write or call today!

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hardness points as converted from the indicated microhardness Knoop numbers, whereas the core itself must conform to blueprint physical requirements. Thus the degree of surface decarburization effect must be controlled to a spread in a very narrow range of approximately 30 Knoop-hardness numbers.

This type of control as applied to a production part is unique in itself as is the problem of controlling the processing equipment for such control. A neutral salt bath itself does not remain in this equilibrium condition unless properly rectified. The time cycles involved and the induced impurities would soon cause a bath of neutral potential to actually decarburize a material of a higher carbon potential than the bath itself relative to this very narrow range. Thus it is found necessary not only to maintain cleanliness by gas rectification but also the proper carbon potential by additions of rectifying agents.

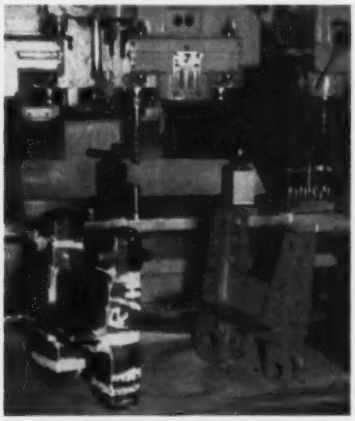

FIG. 6. Forged hinge fitting and finish-machined fitting. As-forged weight is approximately 100 pounds and machined weight is 38 pounds. Note extensive milled areas and assembly holes.

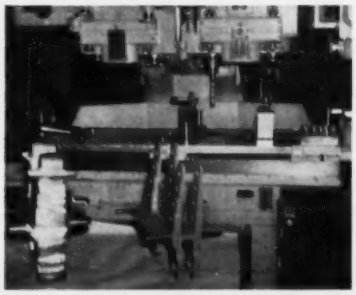

FIG. 7. Front view of forged and machined fitting. Note extensive required machining.

The maintaining of distortional properties within the close required tolerances, itself involves the use of massive tempering fixtures, Figure 7, as well as clamping fixtures in the cooling cycle of the martempering process. Compare the 38 lb. weight of the actual fitting to the 275 lb. tempering fixture. Such fixtures are required to hold the lighter projections of the fitting to tolerances during the draw cycle, at which time the mobility of the metal is established to fixed points.

It is not unreasonable to assume that with the advent of materials of still higher strength, the type of heat-treat control will similarly become increasingly more exacting as will also the type of processing equipment become more specialized and complex.

From Paper No. 237, "Special Heat Treat Techniques—Some Case Studies," presented at the 27th ASTE Semiannual Meeting. Copies of the complete paper are available for purchase from Society Headquarters.

Heat Treating Equipment

BUILT TO LAST

Unretouched Photograph of RETORT After 5½ Years Continuous Service *

Retort was fabricated of RA 330 Alloy for use in a pit type carburizing furnace.

All Standard size Retorts can be delivered promptly.

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NEWS TO HEAT TREATERS...

Pittsburgh Firm Expands

A. M. Cox, president, Pittsburgh Commercial Heat Treating Company, a division of Cox Industries, has announced expansion plans for the firm's 49th Street, Pittsburgh, plant.

PCHT, already one of the largest heat treating concerns in the country, will add over 1,500 feet of floor space. Additional facilities will also be added, including two new car-bottom furnaces, one which will be 12 ft. by 35 ft. and 8 ft. high.

The new facilities will enable the firm to handle the largest heat treating projects. Commenting on the expansion, Elmer Cox, vice president, said the expansion is necessary to meet the increased volume which was experienced in the past two years and which is expected to continue throughout 1960.

Part of the reason for the increased volume, he explained, in addition to the increase in the traditional uses of heat treating, is its use in various phases of high speed jets, missiles and rockets in which the company is extensively involved.

For further information circle No. 1

Heatbath Emulsion Cleaner

Heatbath Corporation has introduced Heatbath Emulsion Cleaner No. 1, an emulsifiable solvent-type cleaner that is used to remove solid dirt and heavy oil films from all metals. This cleaner can withstand heavy oil and dirt contamination and is not harmful when dragged into alkali cleaners.

Heatbath Emulsion Cleaner No. 1 is used as received. The work to be cleaned is immersed and allowed to remain from several seconds to 10 minutes. Pressure spray and/or running water rinses are used after draining to give a rapid dispersing action as the cleaner emulsifies, removing the oil films and solid dirt present. With good rinsing, many processes require no further cleaning.

Among the uses and advantages that Heatbath Emulsion Cleaner No. 1 offers are: precleaning of steel prior to plating, phosphating and blackening, no harsh action or odor, high tolerance for oil contamination, long life and no heating required.

For further information circle No. 2

Rex Company Contract

J. W. Rex Company of Lansdale, Pennsylvania, has been awarded a contract for $2,572,736 to produce 120 millimeter armor piercing shells by the United States Army Ordnance District, Philadelphia.

The company will produce two types of the 120 millimeter projectiles under a schedule starting in May of this year to February, 1961. One type, armor piercing, is reputed to be capable of penetrating any type of armor now in use, and the other called TP, target practice, will be used for training purposes.

J. Walter Rex, President of the Lansdale company, said that as the result of the contract it is anticipated that approximately 100 employees will be added to the present company payroll.

For further information circle No. 3

New Barkling Agent

Through an arrangement announced by Leon B. Rosseau, president of the Ajax Electric Company, Philadelphia, Pa., this firm will handle sales and service throughout the United States on the gas-fired furnaces produced by the Barkling Fuel Engineering Company, Chicago. In the past, Barkling distribution has been confined largely to Midwestern states.

In addition to the well-known Ajax salt bath furnaces developed in this field, Ajax Electric will now offer a complete line of Ajax Barkling gas fired heat treating and melting furnaces. These will be sold and serviced by Ajax sales-engineering representatives in 20 strategically located industrial centers throughout the nation.

Included in the Ajax-Barkling line will be gas fired pot type heat treating furnaces for use with salt or lead, furnaces for melting all nonferrous metals, small tool and shop furnaces for general hardening, large and small oven-type furnaces, full muffle furnaces, and oven-type and slot-type forge furnaces.

Ajax-Barkling furnaces will continue to be produced at the Barkling Chicago plant.

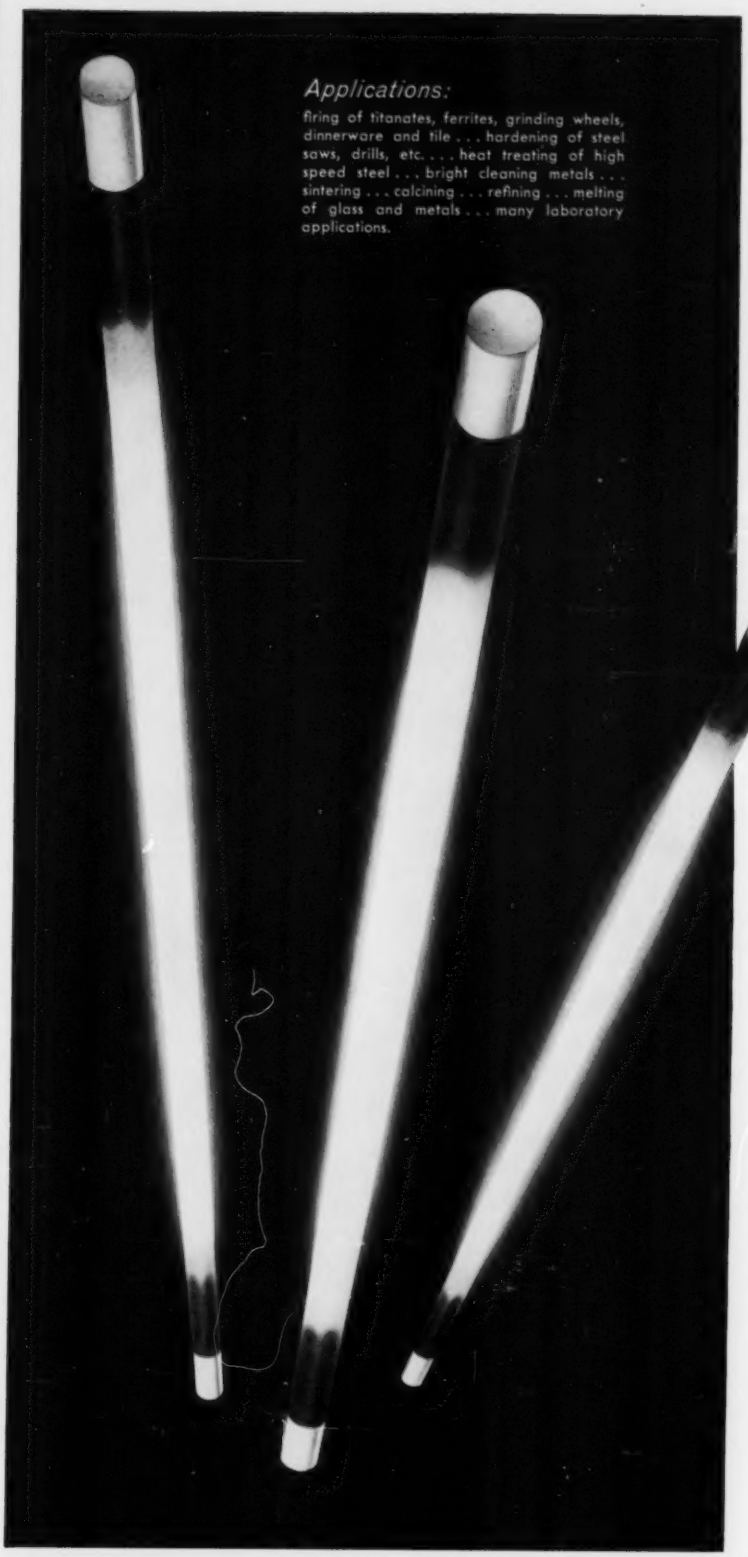
For further information circle No. 4

New Scale Preventive

A new coating which prevents scale formation on metal during heat treatment has been announced by H. A. Storms, chief engineer of the Los Angeles Division of North American Aviation, Inc. The new product will permit faster and cheaper heat treatment of metals. Applications include stainless steel, nickel-chrome alloys, cobalt alloys, copper alloys, and the new exotic alloys now under development.

Applied by spraying or dipping, the new scale preventative, which has been tradenamed "Skalix," adheres to the metal at furnace temperatures forming an oxygen-tight seal. As the metal cools, the coating pops off by itself. In many cases no further processing is necessary.

Continued on page 30


Applications:
firing of titanates, ferrites, grinding wheels, dinnerware and tile . . . hardening of steel saws, drills, etc. . . . heat treating of high speed steel . . . bright cleaning metals . . . sintering . . . calcining . . . refining . . . melting of glass and metals . . . many laboratory applications.

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Norton CRYSTOLON® "Hot Rods" consistently outlast other types of non-metal electric heating elements . . . both in intermittent and continuous operation . . . in furnaces and kilns. They require less frequent changing and fewer changes in voltage taps. One-piece, non-welded "Hot Rods" are straight and strong . . . provide unmatched heating uniformity, electrically, efficiently, economically. Standard sizes readily available. Send for booklet: *"Norton Heating Elements."* NORTON COMPANY, 622 New Bond Street, Worcester 6, Mass.

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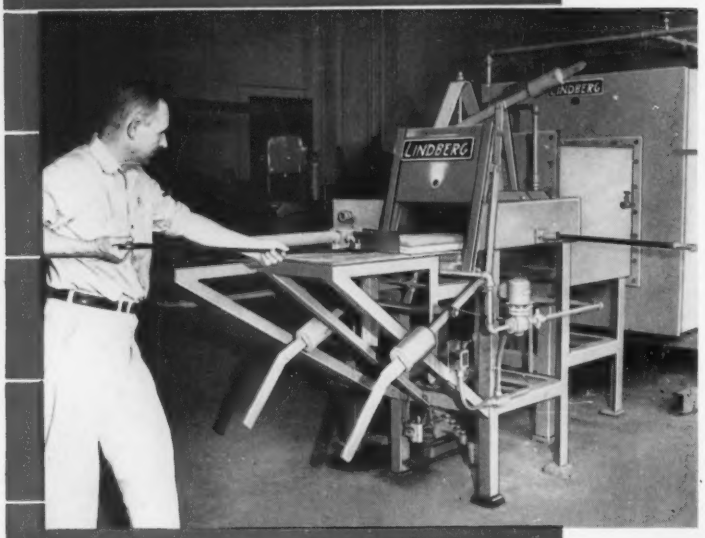
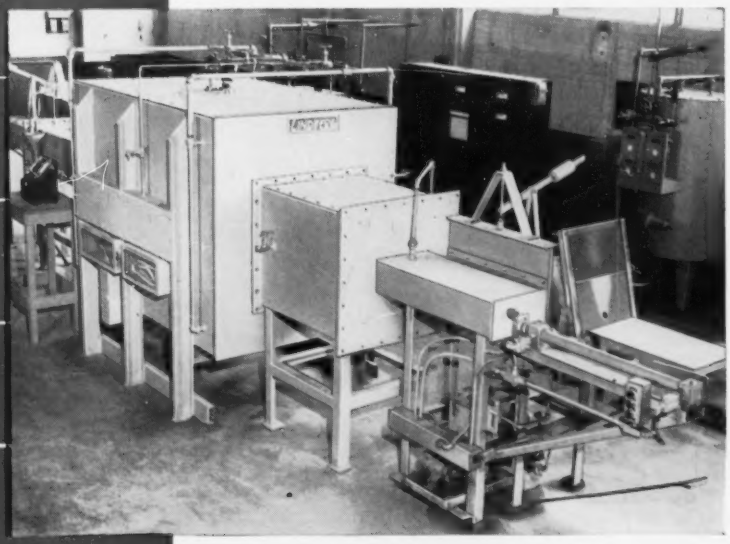
NEW LINDBERG FURNACE PROVIDES IMPROVED EFFICIENCY FOR STAINLESS STEEL SINTERING

This Molybdenum Element Atmosphere Pusher Type Furnace embodies high temperature refractories suitable for low dew point without muffle



This new furnace provides an improved method for sintering stainless steel compacts in hydrogen or dissociated ammonia. A development of Lindberg's engineering staff, you can depend on the most efficient, economical and trouble-free service from it. Furnace provides side loading and discharge parts with purging chambers. Work trays, ceramic slabs or molybdenum boats, move through the furnace by hydraulic pusher. In the installation illustrated below ammonia dissociator and control panels are shown at the right. Hydrogen supply cylinders are located outside the building. For full information on this and Lindberg's complete line of sintering and brazing furnaces just get in touch with your local Lindberg Field Representative (see classified phone book) or write us direct. Lindberg Engineering Company, 2466 West Hubbard Street, Chicago 12, Illinois.



Type MOP-1230-A60C Molybdenum Element Atmosphere Pusher Furnace. Maximum Temperature 3000°F. 60 KW input. 12" wide, 30" long, 7" high. 60" cooling chamber. 36" long preheat chamber.

LINDBERG heat for industry

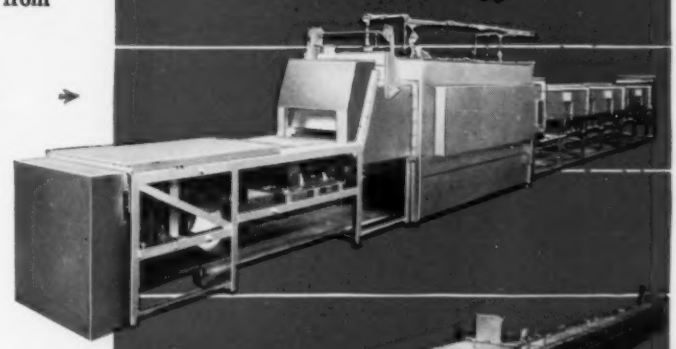
As it does in all types of industrial heating equipment, Lindberg provides a complete line of sintering and brazing furnaces. For example:

This Hand Pusher Batch Type Furnace

is used for small production lots and experimental sintering. It is an all-purpose unit for operation from 1300°F to 2500°F. Made in various sizes for sintering from 25 to 300 pounds per hour.

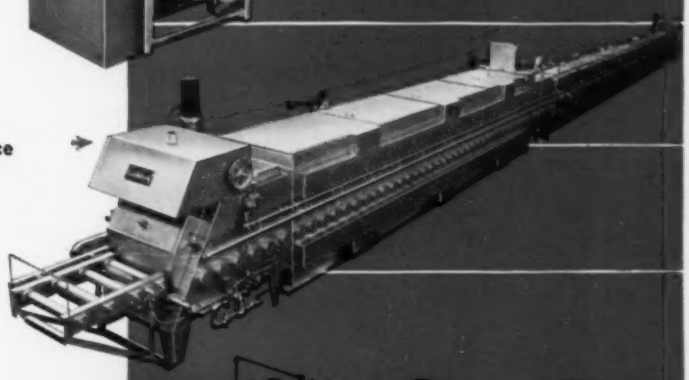
This Mesh Belt Continuous Type Furnace

is a popular sintering furnace for small light parts in copper, bronze, brass or steel with a temperature range from 1300°F. to 2100°F. It can be used for low temperature silver brazing, bright annealing, as well as sintering of powder metals. Production ranges up to 500 pounds per hour.



This Roller Hearth Continuous Type Furnace

is especially designed to handle heavier loads up to 2200 pounds per hour. It has an effective temperature range from 1300°F. to 2100°F. It can be used for bright annealing, low temperature silver brazing as well as sintering of powder metals.



Atmosphere Generators

To obtain the best work from any sintering furnaces, the proper atmosphere is required. The atmosphere generators described here provide the proper atmospheres recommended for use with Lindberg Sintering Furnaces.

1. The HYEX Generator produces atmosphere composed of approximately 4% carbon dioxide—19% hydrogen—12% carbon monoxide and 65% nitrogen.

2. The HYEN Generator produces a neutral atmosphere composed of approximately 21% carbon monoxide—40% hydrogen—38% nitrogen and 1% methane.

3. The HYAM Generator produces atmosphere composed of approximately 75% hydrogen and 25% nitrogen.

If you have a sintering or brazing problem why not talk it over with Lindberg. Just get in touch with your nearest Lindberg Field Representative or write us direct.

LINDBERG
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2466 West Hubbard Street, Chicago 12, Illinois
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Bear in mind—it takes SKILL and EXPERIENCE to Heat Treat Metals . . . Your Commercial Heat Treater provides BOTH

It takes more than equipment, no matter how modern, to perform the complex heat treating processes required today to achieve the property specifications of many metals.

Without the proper combination of operational skill and technical knowledge developed by years of experience, even the most mechanical, up to date equipment can become a menace to your product and a destroyer of your business.

Today the commercial heat treating industry has definitely established its position as the source of skilled, experienced heat treating for all types of metals. Whatever your heat treating problem, always consult your commercial heat treater FIRST.

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Springfield Heat Treating Corp.
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Greenman Steel Treating Co.
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6233 Navigation Boulevard, Houston 11
Houston Heat Treating Company, Inc.
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Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

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Allied Metal Treating Corp.
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Metal Treating, Inc.
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Supreme Metal Treating Co.
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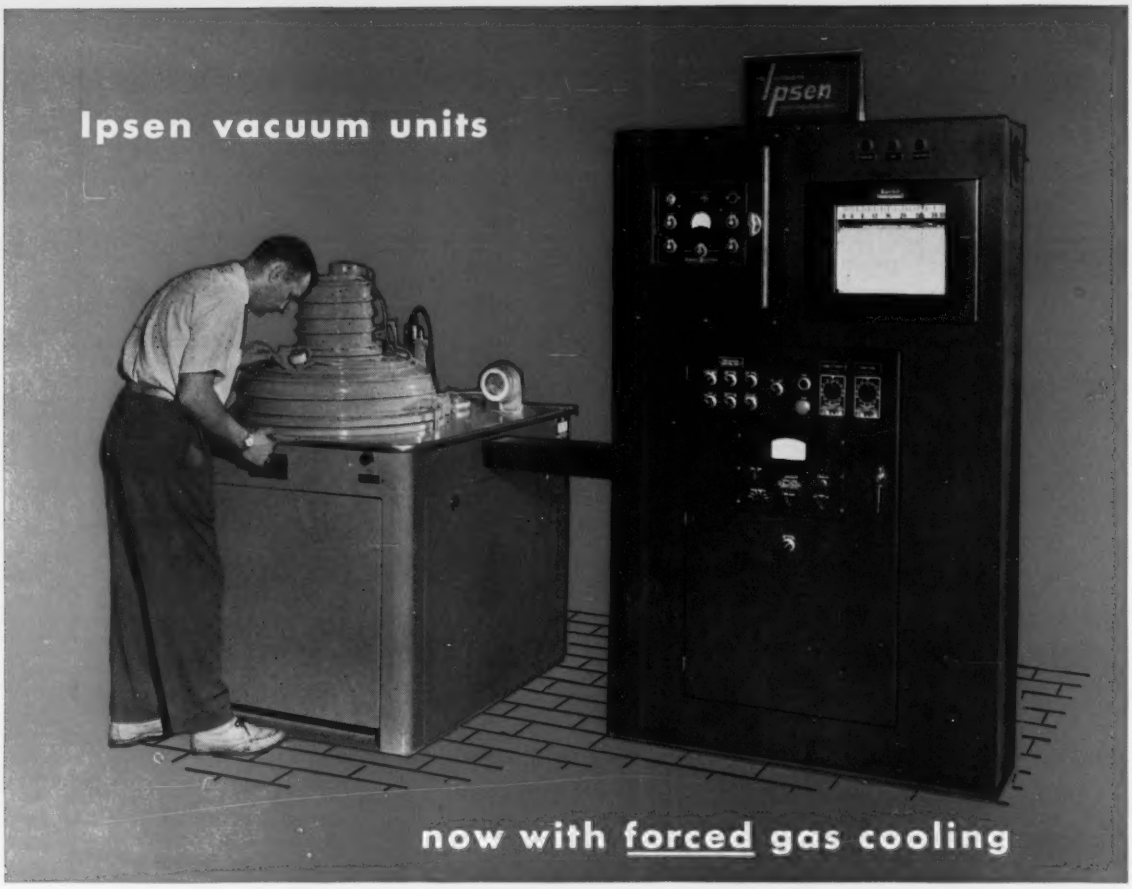
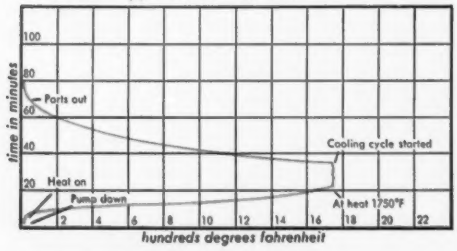


Ipsen vacuum units with *fast gas cooling* now offer a safe and economical method for bright hardening and annealing of stainless steels, high-speed steels, tool steels, and high temperature alloys; also, sintering and brazing of high temperature alloys!

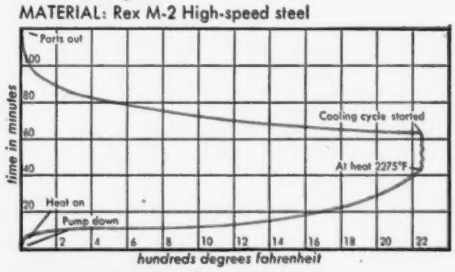
Here are typical examples of performance by the VVFC-1014-E furnace pictured above:

PARTS: Aircraft quality screw fasteners
MATERIAL: Type 410 stainless steel



COMPLETE TIME CYCLE: 1 hour 8 min.
RESULTS: Rockwell C 42-43
APPEARANCE: Exceptionally bright

PARTS: Boring bars
MATERIAL: Rex M-2 High-speed steel



COMPLETE TIME CYCLE: 2 hours 10 min.
RESULTS: Rockwell C 64-66
APPEARANCE: Exceptionally bright

A complete line of standard vacuum units is available. Also, vacuum facilities are available in which processing, testing, and analysis can be made to recommend the proper equipment for your parts. For detailed information contact Ipsen Industries, Inc.

AUTOMATIC Ipsen HEAT TREATING UNITS

IPSEN INDUSTRIES, INC. • 733 SOUTH MAIN STREET • ROCKFORD, ILLINOIS

HEAT TREATING PIPE WRENCH PARTS in Inconel wire heat treat basket at Ridge Tool Company, Elyria, Ohio. In basket design, wire members made of Inconel alloy are formed into spaced loops to hold support rods. Baskets hold 250 lbs, have given 24 months' service so far. Made by the Bix Company, Wellington, Ohio.

After 2 years of carbo-nitriding service...

"looped wire" heat treat baskets look (...and perform) good as new!

After more than 24 months of gas carburizing service, these heat treat baskets are still carrying full loads. Still no failure. Still no repairs of any kind.

The reason: sides and bottoms are made of Inconel* nickel-chromium alloy wire. The manufacturer – The Bix Company – took full advantage of the properties of Inconel alloy... fabricated the baskets with a unique "looped-wire" construction.

Bix chose Inconel alloy because it can be used in relatively small cross sections and still provide excellent high temperature strength... resistance to attack and damage from repeated heat and quenching cycles.

Workability is an extremely important factor, too. Inconel alloy can be readily formed, welded and machined – and reworked if changes are necessary.

For particulars on the Bixco Heat Treat baskets, write The Bix Company, Fairgrounds Road, Wellington, Ohio. For particulars on Inconel alloy and a list of practical applications where Inconel alloy's unique properties can be put to work for you, write for "Keep Operating Costs Down When Temperatures Go Up." A postcard will do. *Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCONEL®

Necessary for controlled production in heat treating

Alnor DEWPOINTER®

for Determining Carbon Potential

The atmospheric condition in a heat treating furnace is accurately indicated by the Alnor Dewpointer. A sampling tube from the furnace connected to the Dewpointer makes it possible to check the carbon potential of furnace atmosphere almost instantly at any time during the process.

The Dewpointer can easily be disconnected and moved to other furnaces. The consistency of accurate readings by different operators on different furnaces is evidence of the reliability of the Dewpointer and the ease of operating.

To make a test, a sample taken from the furnace is put under pressure in the observation chamber and then released quickly to atmospheric pressure. If the expansion cools the gas below its dew point a distinctive fog is observed. This is repeated until the fog vanishing point is reached and the end point determined on the pressure ratio gauge. The exact dew point is indicated immediately. The model 7000-U Dewpointer is priced at $410.00.

Write for bulletin 2051

Alnor INSTRUMENTS

ILLINOIS TESTING LABORATORIES, Inc.

Room 556, 420 N. LaSalle St., Chicago 10, Ill., U.S.A.

NEWS TO HEAT TREATERS

(Continued from page 22)

Storms noted that previously the best procedure for heat treating metal without scale formation was by use of inert gas atmospheres in special furnaces. However, this is an expensive method necessitating a large outlay of capital and causing a large increase in price of parts.

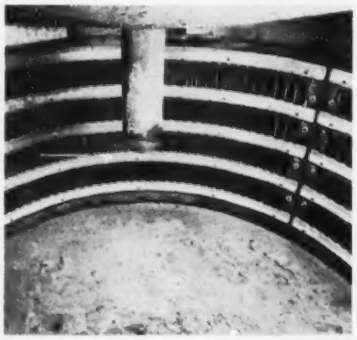
The new coating is relatively inexpensive and a gallon will cover approximately 1,500 sq. ft. of metal surface. The invention resulted from North American's company-sponsored research program that has already produced a number of major developments in metal forming and use.

For further information circle No. 5

No Down Time

The Barrett Division, Allied Chemical and Dye Corp. has had sixteen years of continuous radiant heating of their asphalt kettles from two Trent "Folded and Formed" electric heating units.

Officials at Barrett's Chicago plant found the heating jackets still in excellent condition when replacements, made necessary only by new voltage requirements, were made.



Elements in the units are nickel chromium alloy ribbons supported in highest grade refractory porcelain. They are capable of operating at temperatures to 2,000 F. without pressure equipment at maximum heat input and with a rapid heat decline after the unit is de-energized. Heat zone control is also available with this type of heating unit.

Asphalt kettles are but one of the many applications for these elements. They can also be used in ovens, kettles, furnaces, heating racks, and may be custom designed to suit any operation.

For further information circle No. 6

New Marshall Unit

Availability of a new high vacuum furnace, known as the Model 58-HD, for making hardness tests at temperatures up to 3,000 F. has been announced by Marshall Products Company.

Heating element is a cylinder of sheet molybdenum 3" I. D. by 12¾" long. The element and its surrounding radiation shielding is provided in a single unit assembly for easy removal and access to the assembly as well as to the interior of the plated tank for cleaning and polishing.

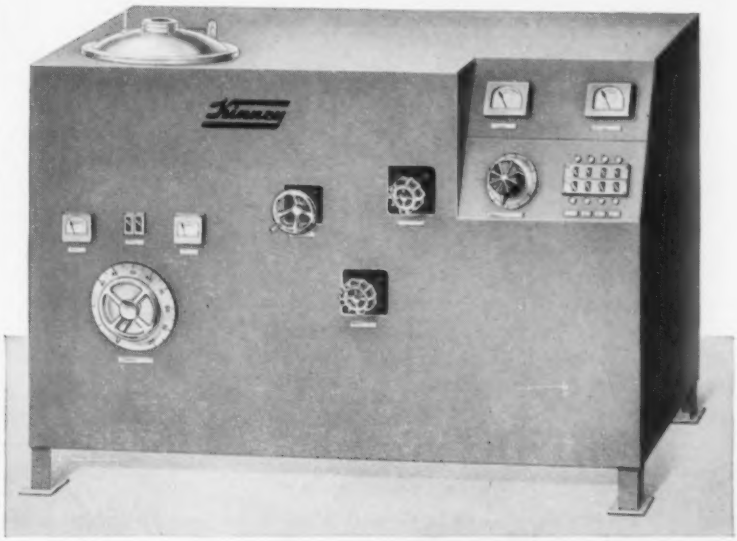
Other features included in the unit are: loading mechanism entirely within the vacuum system to eliminate external error, indentor movement so that hardness impressions may be made on three different reference circles, 360 degrees rotation of anvil and stage for maximum number of impressions without breaking the vacuum, and stationary platinum-rhodium thermocouple beneath specimen despite rotating stage; 2.5 KG or 5.0 KG load may be applied to the indentor.

Measuring 11" O. D. by 38" overall height, excluding floor mounted support stand, the 58-HD furnace is designed with Heli-arc welds and O-ring seals on all ports, flanges, and similar sections, for leak-tight joints. It may be readily evacuated at room temperature to a pressure of 1×10^{-5} mm mercury by a 2" diffusion pump backed by a 4 cu. ft. rotary gas ballast double-stage pump.

The furnace operates on approximately 7 volts AC, 1 phase, 1,400

Continued on page 32

VACUUM SINTERING



TEMPERATURES TO 2200° C · · · PRESSURES TO .01 MICRON

Kinney®

SINTERING FURNACE

For production as well as laboratory use in such operations as: the production of refractory metals through hydride decomposition, sintering of Tantalum anodes and high temperature ceramic reactions. This KINNEY High Vacuum Furnace fulfills the needs of applications where very low pressures and residual atmosphere of high purity are required. Write for full information on this and other new developments in KINNEY High Vacuum Furnaces.

KINNEY VACUUM DIVISION
THE NEW YORK AIR BRAKE COMPANY
3594D WASHINGTON STREET • BOSTON 30 • MASS.

WRITE: for Bulletin No. 4510 Describing New Developments in Kinney High Vacuum Furnaces.

Please send me Bulletin No. 4510 and full information on KINNEY Sintering Furnaces.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

amperes in conjunction with special transforming equipment. Maximum input to the heating element is 12 KW.

The 58-HD furnace is available separately or as a complete package test set-up of furnace, vacuum equipment, temperature control and electrical equipment, furnace support stand, and sapphire indentor.

For further information circle No. 7

New Ipsen Plant

A new manufacturing plant has been announced by Ipsen Industries, Inc., of Rockford, Illinois. The 128 acre site lies two miles northeast of Cherry Valley, Illinois. Manufacturing operations in the modern fireproof building started last December.

The single story structural steel building has masonry walls and occupies 40,000 square feet. Planned with an eye to future development, the building has two non-bearing exterior walls which can be knocked down for future expansion. All interior walls are movable. The flat bi-level steel decked roof provides a 21 ft. ceiling over half the plant area, and a 14 ft. ceiling over the remainder.

Departments housed in the new building include fabricating, assembly, electrical, shipping and receiving, and the stockroom. An experimental and development department has complete, up-to-the-minute facilities.

This step in the planned expansion program of Ipsen Industries is expected to keep pace with the firm's activities in the manufacture of equipment in widening fields of heat treating operations. Ipsen Industries has pioneered developments in automatic straight-through heat treating operations, high temperature 100% forced convection heating, complete atmosphere protection during both heating and quenching cycles, high temperature carburizing, dewtronik and carbotronik instrumentation.

A separate ofice building to include sales, service and engineering facilities will be built on the same industrial site. Its completion, expected by the end of 1960, coupled with modern landscaping plans, promises to develop a "campus-like" setting to the industrial site.

For further information circle No. 8

Thermomelt Holder

An ingenious dispensing device which has enhanced the successful introduction of a new line of temperature indicators for the metalworking industry and other fields where heat or heat treating is used is now available. Developed for use with the Markal Company's Thermomelt Precision Temperature Indicators in stick form, the device consists of a two-piece metal holder and dispenser.

Markal Thermomelt Indicators melt at predetermined temperatures. Mark or stroke surface with Thermomelt "Stik." The mark melts when stated temperature is reached.

Objective of the holder is twofold: it must protect product from breakage, and it must be easy to dispense stick as it is used up. A holder comes with each stick as a complete package.

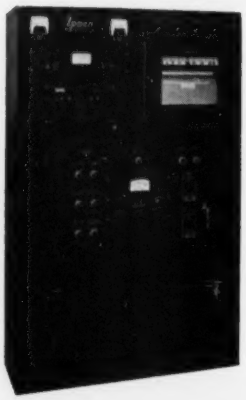
Around the tubular part of the holder is a metal collar which, when drawn up to the dispensing end, securely retains the stick in any desired marking length. By sliding the collar toward the base of the holder, the stick can be either drawn out or retracted as desired.

Thermomelt is used by engineers and metallurgists in such fields as heat treating, welding, metal casting, metal forming, ceramics, plastics, rubber molding and in defense and power plants. A total of 63 exact temperature ratings from 113 to 2,000 F. are available in stick, pellet and liquid form.

For further information circle No. 9

High Vacuum Furnace

An automatic high vacuum cold wall type furnace with a work space 26 in. wide, 26 in. deep, and 24 in. high, with a 200-lb. capacity has been announced by Ipsen Industries, Inc., Rockford, Illinois. The general purpose vacuum heat treating unit will be used for high temperature copper brazing and heat treating of gas turbine parts and assemblies.



The furnace, series V-5-750, has an operating temperature of 2,600 F., a maximum operating pressure of 0.1 micron Hg, and takes a power supply of 150 kw/hr. It has a transformer built in for operating 110V control circuits. Total floor space required is 10 ft. 10 in. by 13 ft. 10½ in. which includes the furnace, the vacuum system, control panel and power panel. The furnace is charged horizontally and has a molybdenum hearth. The charging door is side hinged and is equipped with a sight glass for viewing the work during heating. The pumping system consists of a 120

Continued on page 34

From left to right, Mr. Karl Woerle, Foreman, Mr. Neil Paterson, Supervisor of Tools and Equipment, Mr. Robert Settles, Park Chemical Company Representative.

Hamilton Standard gets better results from Park Aluminum Brazing Salt

In many cases, dip brazing in salt baths is the most practical method of joining aluminum. Extremely thin gage aluminum can be handled without damage from pitting or distortion because of uniform heating, close temperature control and the buoyancy of the molten bath. Salt brazing is often the only way complicated assemblies such as heat exchangers can be brazed successfully.

Park Aluminum Brazing Salts are superior to other fluxes because of their better fluidity, greater stability, freedom from sludge and ease of cleaning. They act as both flux and heat transfer medium for all dip brazing operations on aluminum alloys. Joints can be made by using wire rings, flat shims or brazing sheet. Assemblies of various sizes and shapes can be brazed at the same time, saving time and labor.

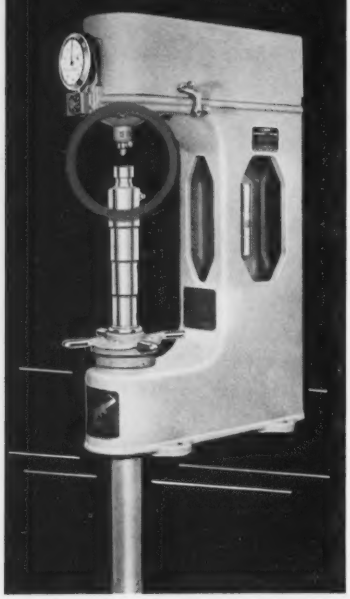
Hamilton Standard's work includes a variety of aircraft parts requiring a high quality bond. It is important that an aluminum brazing salt be used that meets their high standards of quality. Park Aluminum Brazing Salt D has produced quality brazing efficiently and economically for Hamilton Standard. Separate additions of costly chlorides have been eliminated. Laboratory and maintenance control has been reduced to a minimum. The problem of desludging three times a week has been reduced to checking for sludge once a week. The stability and reliability of Park Aluminum Brazing Salt has been amply demonstrated.

For detailed information on Park Aluminum Brazing Salts and their applications, send for technical bulletins or contact your nearest Park representative.

Park

PARK CHEMICAL COMPANY • **8074 Military Avenue, Detroit 4, Michigan**

GUARANTEED ACCURATE

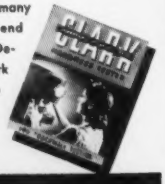


The Most for Your "Rockwell Testing" Dollar!

Clark Hardness Testers are *guaranteed* accurate for all "Rockwell Testing". Clark's exacting workmanship in the production of penetrators, testing blocks, anvils, and other accessories pays off in exceptional accuracy on the job. No wonder the low cost surprises our first-time customers. *Clark Instrument, Inc., 10205 Ford Road, Dearborn, Mich.*

FREE REFERENCE BOOK

All information about hardness testing in easy-to-read text with many illustrations. Just write "Send Book" on your letterhead. Description and prices for Clark Hardness Tester and free Hardness Conversion Chart also available on request.



CLARK INSTRUMENT, INC.
10205 FORD ROAD
DEARBORN, MICHIGAN

Missile-Age Accuracy

NEWS TO HEAT TREATERS

c.f.m. mechanical pump and a 16 in. diameter vapor diffusion pump capable of a pump-down time from atmosphere to 1 micron Hg in less than 20 minutes.

The power panel of the V-5-750 vacuum furnace houses the main power transformers, the main contactor, the current transformer for ampere and voltage indicators. The control panel has a switch allowing the furnace to be set for manual or automatic operation at the will of the operator. The entire heat treating sequence, including time at temperature and cooling cycle, can be operated automatically. All operations or any single operation can be changed from automatic to manual at any time during the sequence. Shown here is the control panel for the series V-5-750.

For further information circle No. 10

Improved Tooth

An improved tooth by tooth gear hardening machine for 6 in. to 60 in. diameter and 1 to 5 diametral pitch gears has been announced by Ajax Magnethermic Corporation.

The tooth by tooth gear hardening machine features complete auto-

it's significant that

COMMERCIAL HEAT-TREATERS

like **METALLURGICAL PROCESSING CORP.**

U. S. Patent No. 2,818,246 (Kappel)

...are the most **ENTHUSIASTIC** *operators of the NEW*

ROLOCK® CARBON POTENTIAL CONTROLLER

Yes, commercial heat-treaters . . . men who depend wholly on the cost-efficiency of their equipment and the competitive high quality of their work . . . have been among the first to see the unique advantages of this entirely fresh approach to Carbon Potential Control. "The finest thing of its kind and a really practical, dependable solution to the problem," says Mr. Louis Perlman, President of Metallurgical Processing Corp.

Other heat-treaters and heat-treating department heads agree. Here is a relatively simple, fully engineered system that works.

THESE OUTSTANDING ADVANTAGES CAN BE YOURS TO ENJOY, TOO!

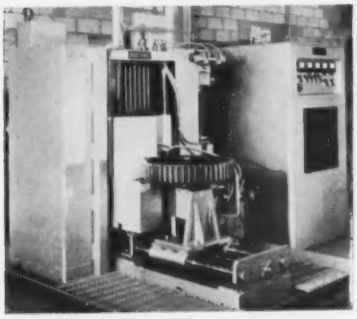
Measures carbon potential of gas *continuously* by an entirely NEW method • Once properly adjusted to furnaces and gas generators, the control action is precise and dependable • Requires a minimum of attention . . . does not call for specially trained operators • Permits far more uniform control of furnace atmospheres and hence results in more uniform, clean, high-quality work.

For further information write to the Rolock Engineering Department.

ROLOCK INC., 1332 KINGS HIGHWAY, FAIRFIELD, CONN.

IRL608

matic indexing and scanning and a pedestal with two hub adaptors, adjustable with lead screw and crank. This unit is now completely hydraulic with temperature compensated scan speed control valves. Cam bars for length of stroke and control of heat and quench are mounted on the front for greater operator convenience. An inductor ground detector is available to prevent damage to the inductor or gear in the event of misalignment.



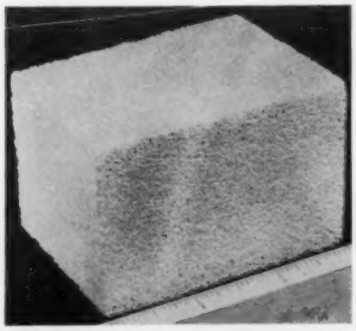
The tooth by tooth induction heating method hardens teeth from one tip through the root to the tip of an adjacent tooth. The highly stressed root zone is strengthened for greater load-carrying ability. Tooth faces are fully hardened for maximum resistance to abrading and pitting. Compressive residual stresses at the surface in the root greatly improve fatigue life.

For further information circle No. 11

Hi-Temp Ceramic Brick

Ipsen Super Alloyed ceramic material used successfully for radiant tubes, furnace fans, and thermocouple protection tubes has been joined by a companion material of extreme refractoriness which has been made into a high temperature lightweight insulating brick. This ceramic brick was developed by the Ceramic Division of Ipsen Industries, Inc.

The material is formed in convenient brick size of 2½ in. by 4½ in. by 9 in. This exclusive formulation of aluminum oxide material is expanded and then fired. This creates a cellular structure in which all cells are interconnected. Its absorbent property permits gas to pass through for purging or evacuation. This material has the density or weight of a 1,600 F.



insulating firebrick, and an insulating value comparable to a 2,300 F. insulating firebrick. It can be operated up to 3,400 F. It can readily be cut, sawed, or filed.

This type of insulating ceramic material has a wide range of application in the nuclear, metallurgical, chemical, and aeronautical industries. In the high temperature metallurgical field it has immediate acceptance as lining for hydrogen furnaces, for vacuum processing, and as a catalyst support in generators.

For further information circle No. 12

Aircraft Salt Bath

Amco-Weld, Incorporated has placed in operation a Lindberg-Upton Salt Bath Furnace for the heat treating of supersonic aircraft parts manufactured in their Abilene plant.

The high temperature salt bath furnace provides the rapid heating cycle required, precise temperature control and thermal efficiency necessary in the heat treating operation.

For further information circle No. 13

DON'T BE AN OSTRICH !

6.1% OF INDUSTRIAL FIRES ARE CAUSED BY METAL TREATING OPERATIONS

HANNITE is Non-Flammable

CONTROLLED QUENCHING RATES

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Lepel

HIGH FREQUENCY INDUCTION HEATING UNITS

HARDENING · ANNEALING · ZONE REFINING · CASTING · FORGING · SOLDERING · BRAZING

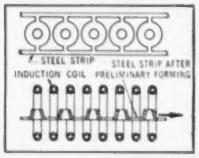
Lepel induction heating equipment represents the most advanced thought in the field of electronics . . . the most practical and efficient source of heat developed for numerous industrial applications. You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations.

TYPICAL INDUCTION HEATING APPLICATIONS

PLASTIC COATING OF TOOL HANDLES

A production line operation for coating handles of tools at Whitney Metal Tool Co., Rockford, Ill. uses induction heating with excellent results. The handles only are heated by induction to the desired temperature then dipped into a vinyl chloride base coating material for a short period depending upon the thickness of coating desired. The plastic coating formed on the handles is then cured by immersion in a carbo-wax bath.

FORMING OF METAL STRIP FACILITATED BY PROGRESSIVE ANNEALING



Metal forming operations which require intermediate anneals to restore ductility can be facilitated by induction annealing the strip progressively. Diagram illustrates this procedure for partially formed thin austenitic stainless steel strip. The induction annealing operation is scheduled in the production line between two press operations. Metal strip and wire of other materials are also induction annealed in this manner.

WRITE FOR NEW LEPEL CATALOG
Electronic Tube Generators from 1 Kw to 100 Kw.
Spark Gap Converters from 2 Kw to 30 Kw.

Lepel HIGH FREQUENCY LABORATORIES, INC.
55th ST. & 37th AVE., WOODSIDE 77, N. Y.

NEWS TO HEAT TREATERS

Equipment Orders Spiral

Net new orders of $6,827,000 for industrial heating equipment in January 1960 were up 50% above the volume of $4,545,000 attained in January 1959, according to the Industrial Heating Equipment Association.

Net new orders in January 1960 for induction heating equipment totaled $1,068,000, up 6% over the January 1959 volume of $1,004,000. 1959 billings for this segment of the industry amounted to $20,036,000, a gain of 66% over 1958 billings of $12,034,000. The total backlog of induction heating equipment orders at year end 1959 was $8,308,000.

Errata

Sharp-eyed readers have called our attention to an error in the last column of the sales figures for industrial furnaces as presented on page 9 of the January-February issue. Instead of $58,868,179, the total shou'd have been $85,868,179.

High Temperature Baskets

Carburizing boxes which provide maximum design efficiency for many high temperature parts hardening and heat treating applications are available from Wiretex Manufacturing Company, Bridgeport, Connecticut.

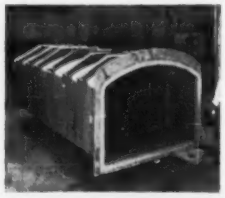
Continued on page 37

Custom FABRICATORS

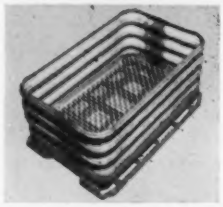
DESIGNERS OF SPECIAL EQUIPMENT

High alloy such as RA-330, Hastelloy and Inconel—for the heat treating industries . . . a plant with over 50 years experience as fabricators, and grey iron castings. Illustrated above is Venturi-High Temperature Alloy.

Alloy muffle . . . example of one type fabrication job.



Corrugated baskets.



Pickling racks.

Fully illustrated colored brochure shows many types of Custom Fabrication . . . write for it today.

BERLIN CHAPMAN CO. Since 1908

Division of BERLIANA CORP.
BERLIN • WISCONSIN

NEWS TO HEAT TREATERS

The boxes include design features developed through years of custom manufacture of fixtures for specific high temperature jobs. According to manufacturers of high heat resistant alloys used in such applications, design is often the key determinant of job efficiency and maximum fixture life.

Wiretex engineers note that proper design of fixtures for use under temperatures in excess of 1,450 F. is largely dependent upon the type of alloy used and other job specifications. In many cases, a custom manufactured fixture is required for maximum efficiency. Two Wiretex carburizing boxes, however, developed after many years experimentation, have been successfully employed for many high temperature applications which formerly required use of custom-made equipment.

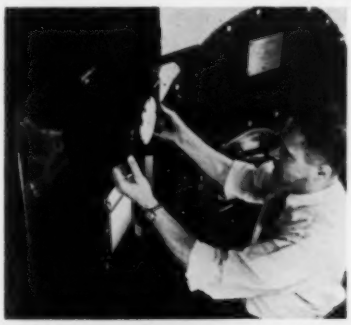
The containers are fabricated from 1/8 in. sheets of Type 330 alloy, a stable, austenitic nickel-chromium combination. Model M-37 is 6 in. wide by 14 in. long and 6 in. high. Model M-39 is 7½ in. by 7½ in. by 9½ in.

Use of Type 330 alloy permits the fixtures to be used in applications where high thermal shock is encountered. Besides its great load carrying strength, it offers high resistance to absorption of carbon and nitrogen in working temperatures, and oxidation resistance up to 1,950 F.

For further information circle No. 14

Furnace Gas Analyzer

A new instrument designed to afford more accurate and reliable analysis of furnace and other con-



trolled atmospheres has been introduced by the Perkin-Elmer Corporation, Norwalk, Connecticut. The P-E 184B Furnace Atmosphere Analyzer is a plant-tested process

Continued on page 38

SILICON CARBIDE HEATING . . .

Concluded from page 9

Hayes reports that element resistance has increased only slightly during the first year of operation.

On-the-line elements also heat furnaces, ovens and periodic kilns in other fields including ceramic and chemical. This equipment is used for such processes as firing ceramics, brazing, annealing, calcining and roasting, and for experimental work.

Continuous Evaluation

Test results on Globar® elements operating on line voltages are continually being evaluated. In a 12,500 hour (over 17 months) test, 26 in. by 9 in. by ⅝ in. elements operating in air at 1,800° F. increased in resistance about 15%.

Eight 34 in. by 12 in. by ¾ in. elements connected two in series in a machine shop furnace operated periodically up to 1,850° F. increased in resistance about 13% in 22 months.

A single 29 in. by 23 in. by ½ in. element was operated recently at 1,650° F. for 4,000 hours, at 50 watts per square inch at 110 volts. The resistance increased 5% during this test.

Four 53 in. by 34 in. by 1¼ in. elements ran for nine months (6,600 hours) at 2,200° F. and increased an average of 25% in resistance.

Increased Interest — Wider Acceptance

Electric furnaces are answering the increasing need for heat treating in protective atmospheres. The adaptability of long life silicon carbide elements, the ease of replacement and minimum maintenance, and the low initial cost are important to furnace operators.

On-the-line operation is opening up entirely new markets for electrically heated furnaces where previously costs were prohibitive.

Completely Packaged

— for shop or laboratory use

PERECO

Electric

FURNACE

FG SERIES

Available in a Number of Sizes

Treating high-speed steel is just one of the jobs which are being handled more efficiently with the accurately controlled, clean electric heat of Pereco Furnaces. Also more economically! This is substantiated by reports from users—representing a cross-section of industry—from all points of the globe. And the FG Series Pereco Unit (illustrated above), with operating temperature to 2500 F., is only typical of many standard models—with a wide choice of controls—available for handling different types of work. Whatever your furnace need may be, it will pay you to investigate a Pereco Furnace.

PERENY EQUIPMENT COLUMBUS 12 OHIO

PERECO ALSO MANUFACTURES STANDARD OR SPECIAL FURNACES FROM 450 F. TO 5000 F.

PERENY EQUIPMENT CO., INC.

Dept. O. 893 Chambers Rd.

Columbus 12, Ohio

Write **TODAY FOR DETAILS**

NEWS TO HEAT TREATERS

gas chromatography instrument employing techniques widely used in petroleum and petrochemical industries. The unit automatically provides more detailed data than other methods, and its high degree of accuracy improves product quality and reduces operator time. It may be employed with auxiliaries to regulate input valves and other system elements.

Applications for the new instrument include heat treat furnaces, endothermic gas generators, kilns and other combustion devices. The analyzer performs an automatic four-component analytical cycle, 5 to 8 components on special order, every ten minutes. Materials usually analyzed are oxygen, carbon dioxide, carbon monoxide and methane. Other components may be added or substituted depending upon the user's requirements.

For further information circle No. 15

New Diffusion Furnaces

A line of precision engineered gaseous and solid diffusion furnaces for the manufacture of quality transistors and semiconductor diodes has been announced by the Pilot Plant Equipment Division of Lindberg Engineering Company.

Furnaces are available in single and multiple zone models, depending upon the temperature uniformity desired. Multiple tube models can be supplied, where floor space is at a premium. Pictured here is the Type G4T8-212 Gaseous Diffusion Furnace, one of the many models available.

A variety of tube sizes, up to a maximum of 4" I.D., are available in the standard line of furnaces. Refractory accessory items can be supplied as part of the furnace.

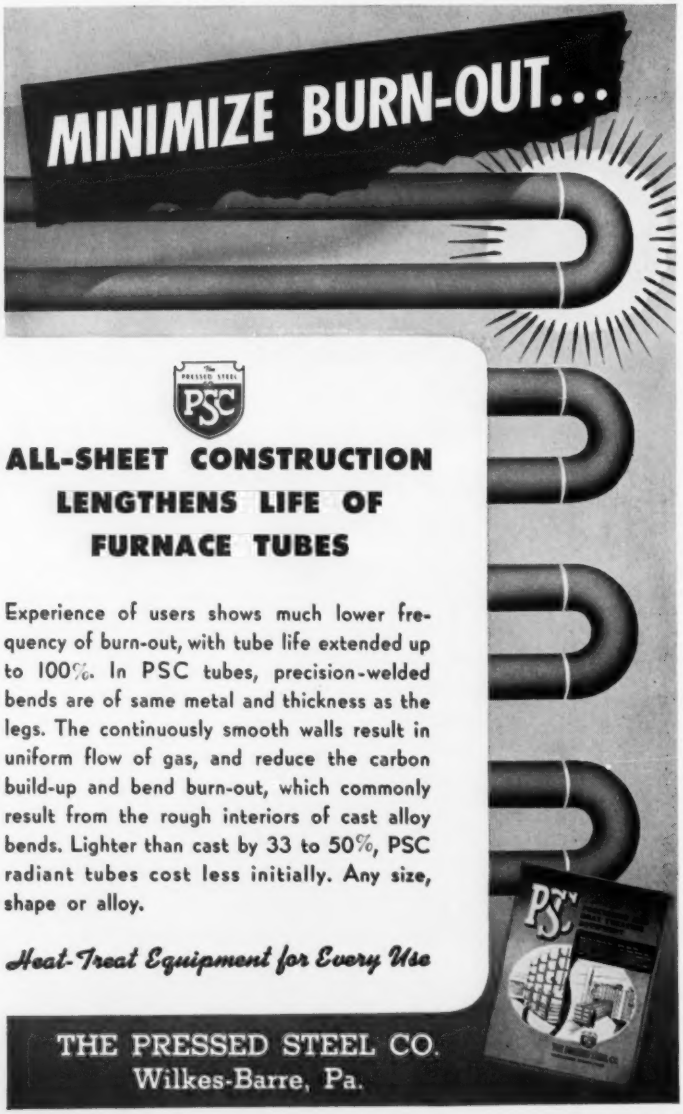
All models are shipped as a complete package, ready for operation upon connection to utilities.

For further information circle No. 16

Vacuum Society Symposium

Cleveland, Ohio's Sheraton Hotel will be headquarters for the seventh national Symposium of the American Vacuum Society. Dates of the conclave are October 12 through 14. Industry members interested in attending should contact the American Vacuum Society, Box 1282, Boston 9, Massachusetts.

Authors interested in submitting papers may contact C. R. Meissner,


MINIMIZE BURN-OUT...
PSC
ALL-SHEET CONSTRUCTION
LENGTHENS LIFE OF
FURNACE TUBES
Experience of users shows much lower frequency of burn-out, with tube life extended up to 100%. In PSC tubes, precision-welded bends are of same metal and thickness as the legs. The continuously smooth walls result in uniform flow of gas, and reduce the carbon build-up and bend burn-out, which commonly result from the rough interiors of cast alloy bends. Lighter than cast by 33 to 50%, PSC radiant tubes cost less initially. Any size, shape or alloy.
Heat-Treat Equipment for Every Use
THE PRESSED STEEL CO.
Wilkes-Barre, Pa.

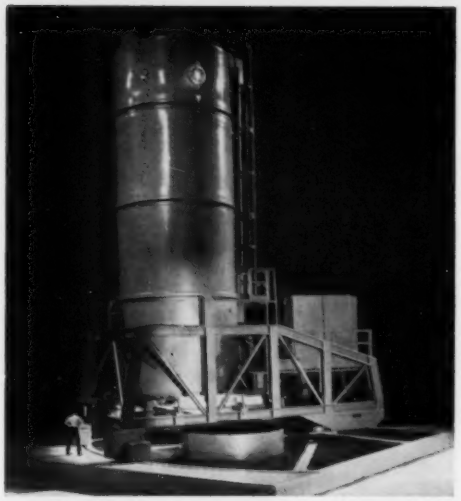
Georgia Institute of Technology, Engineering Experiment Station, Atlanta, Georgia.

For further information circle No. 17

Heat Treat System

The General Electric Company's Rocket Engine Section announces the installation of the world's largest gantry-type heat treat system at its Cincinnati, Ohio, plant. It is scheduled to be operational by late spring 1960. Designed and built by the General Electric Industrial Heating Department at Shelbyville, Indiana, this facility is capable of handling loads measuring 10 ft. in diameter by 30 ft. high.

Main element of the facility is the high temperature Gantry Furnace. It is mounted vertically on a power driven carriage which revolves around a circular pit containing: two pit furnaces for combination preheat, tempering and stress relief; salt quench; still-air quench; water quench-rinse station; and supporting atmosphere-control equipment. Automatic and manual controls are provided for carriage travel and positive gantry furnace-to-pit alignment. Additional pits are provided for proposed oil quench stations. All furnaces and quench tank stations are designed so that they can be extended to handle 40 foot high loads.



World's largest gantry-type heat treat system at General Electric's Cincinnati, Ohio plant.

Furnace power, control power, air, water, water drain, natural gas, and atmospheric gas are supplied to the Gantry Furnace thru the carriage bearing located in the center of the pit.

The Gantry Furnace is elec-

Continued on page 40

BIG SAVINGS!

BUY AT FRACTION OF ORIGINAL COST!

LINDBERG "HYCO" HYDRYZING ATMOSPHERE GENERATORS

500 CFH

Weight: 1720 lbs.

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each unit complete with:

Motor, Blower, Filter, Flow Meters, Magnetic Starter, Push Button and 2 sets of instructions for Installing, Operation and Maintaining.

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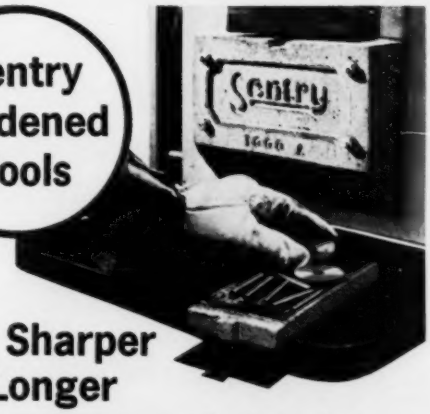
SANTA ANA, CALIFORNIA **Phone: KI 2-9746**

Sentry Hardened Tools



Stay Sharper Longer

There's no better "insurance" against costly, premature dulling of your high speed production tools than reliable Sentry hardening. Sentry's unique Diamond Block provides a truly neutral atmosphere that permits heat treating for maximum hardness without danger of scale or decarburization . . . keeps your production tools sharper longer.

Like a free demonstration? Send us your sample high speed steel tool and we'll Sentry harden it for you free of charge.

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NOTHING heats like... is more modern than... is more economical than... GAS

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INDUSTRIAL GAS BURNERS & FURNACES
Using Only Low Pressure Gas
for Clean, Fast, Quiet Heat-Up at Lowest Cost!

HIGH SPEED FULL MUFFLE FURNACES
Bench type for heat treating high speed and alloy steels. Temperatures to 2400° F.

LARGE FLOOR TYPE OVEN FURNACES
For universal heat treating of larger pieces. Temperatures to 2000° F.

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"BUZZER" Burners & Furnaces for Heat Treating, Melting, Soldering

NEWS TO HEAT TREATERS

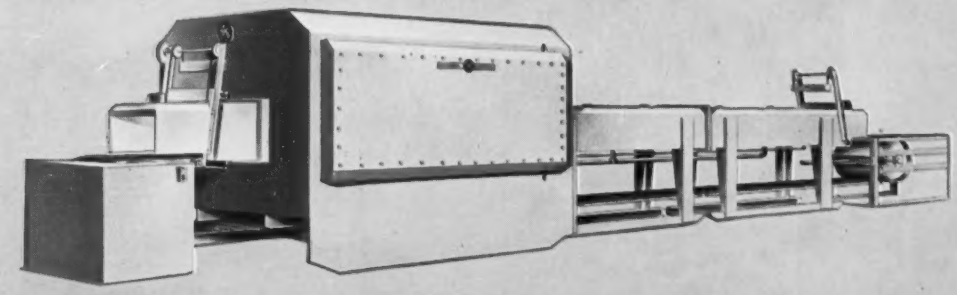
trically heated and designed to maintain continuous close tolerance temperatures, within ± 10 F up to 2,000 F.

Total power rating is 1,030 KW, divided into four controlled zones, providing maximum temperature uniformity regardless of the length of work piece being heat treated.

Endothermic, thermalene, atmosphere gas for the Gantry Furnace is provided by two 4,000 CFH thermalene producers. Each thermalene producer is equipped with a Foxboro dew point controller. This device continuously samples for moisture content of the gas output of the producer. Control devices, operating in conjunction with the Foxboro instrument, automatically control the dew point by changing the ratio of gas and air input to the producer.

Work to be heat treated is transferred between the Gantry Furnace and the pit furnaces by means of a

HEAT
from General Electric



for copper brazing, silver brazing, sintering, bright annealing

Mesh-belt Furnaces from General Electric are specially designed for low-cost, high-volume production. They can be installed in a continuous production line, accepting parts ready for heat processing and delivering the processed parts ready for assembling or packaging. Available with either ribbon or silicon carbide resistors, the furnaces provide reliable, continuous operation with minimum maintenance. Heavy insulation keeps operating costs down and eases working conditions around the furnace. Since these furnaces can achieve substantial cost reductions and quality improvements, they are extremely popular; over 200 General Electric mesh-belt furnaces are now in operation.

Ask your General Electric sales engineer for complete data on G-E mesh-belt furnaces or write for bulletin GED-3881. General Electric Company, Schenectady 5, New York. 758-01

Progress Is Our Most Important Product
GENERAL ELECTRIC

gas tight chain hoist system. This system extends down through the top and operates inside the gantry furnace. The hoist mechanism is driven by a GE Speed Variator which provides hoisting speeds ranging from 5 to 40 ft. per minute and lowering speeds from 5 to 60 ft. per minute.

The two vertical pit-type furnaces may be used for a combination of preheat, tempering and stress relief operations requiring temperatures ranging from 400 to 1,400 F. Maximum temperature variation is ± 10 F. These cylindrical furnaces are refractory lined and insulated steel structures that are designed to accept loads measuring 10 ft. in diameter by 30 ft. high. Total furnace rating is 1,050 KW, divided into four zones of control. Each furnace is equipped with a 21,000 CFM recirculation fan to assure optimum circulation.

The salt quench and water quench-rinse stations are similar in design, construction, and operation. Both are vertically erected, cylindrical steel tanks which are heated by four gas-fired, radiant tube type immersion heaters.

The salt quench equipment is designed for continuous operation at temperatures ranging from 300 to 1,000 F. Rapid, continuous circulation of the molten salt to all points of the work load and tank is accomplished by three solution agitators. Total rated heating capacity is 2,500,000 BTU/HR.

The water quench-rinse equipment is designed to provide water temperatures up to 180 F. Water recirculation is provided by a motor driven 250 GPM pump. The gas burners used with the water rinse heating tubes are rated at 312,000 BTU/HR each, providing a gross input of 1,250,000 BTU/HR.

Metallurgical facilities complementing the new heat treat system include magnaflux, X-ray, tensile and hardness testing, ultrasonic inspection, plus environmental test, stress.

For further information circle No. 18

Plate Treating Line

Construction has started on the new plate heat treating line at the Homestead District Works of United States Steel. This new line is the second to be designed and installed at this plant by the Drever Company, Bethayres, Pennsylvania. While no larger than the first, the line can provide greater production of heat treated plate due to greater flexibility provided for handling plate and from improved combustion design.

The line, built to process plate up to 45 ft. long by 156 in. wide, and 2 in. thick, will consist of a hardening furnace, a tempering furnace and a Drever pressure quench. The hardening furnace will have a maximum temperature rating of 1,750 F. and will be about 18 ft. wide and 142 ft. long. It will handle 18 tons per hour with an average hearth load of 90%.

The tempering furnace provides a maximum temperature of 1,350 F. and can process 22 tons per hour.

Located to receive plate from either the hardening furnace, the tempering furnace or the previously installed stainless plate furnace, the Drever quench utilizes water sprays combined with a platen press. This press keeps the plate flat during quenching. It will have an area of 164 in. x 48 ft. with a pressure of 100 tons. Quench water is delivered at the rate of 21,000 gpm through 34,632 holes.

The continuous heat treating line will be under the control of a single operator located in a room overlooking the line, with complete push-button control and with television monitoring. It is expected to be in operation during the late summer of this year.

Construction of another Drever continuous plate heat treating line at this plant is going ahead at the same time. This new line will treat plate from the 100 in. plate mill and will be used principally for the production of U. S. Steel's 'T' Steel.

For further information circle No. 19

FOR SALE
WHEELABRATORS

Priced For Quick Sale — First come 1st choice. Dealers invited.

2—48x48 Tumblast	**1—8' Pangborn Table Blast**
8—42x48 Tumblast	**1—4' Pangborn Table Blast**
2—27x36 Tumblast	**Dust collectors available if desired.**

Trade-in accepted, Also terms available.
Many other guaranteed rebuilt machines in stock.

Diamond Sales, Inc.
5654 W. Jefferson Ave.
Detroit 9, Michigan

BRAZING OR HEAT TREAT FURNACE

General Electric, gas fired furnace, bell type, complete with blowers, consisting of one bell and four bases for operation up to 2100°F. Each base includes inconel retort with sand seal capable of accepting work measuring 60" x 20" x 7". Connections for controlled atmosphere in retorts. Automatic temperature recorder-controller. Equipment for generating "Exogas" or dissociated ammonia atmospheres also available.

The Griscom-Russell Company
N. B. Miller

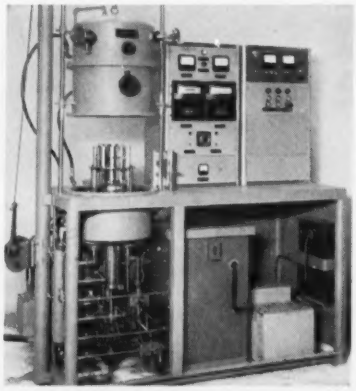
NEWS TO HEAT TREATERS

Hot Hardness Tester

A hardness tester designed to make multiple indentations in reactive or heat sensitive metals at temperatures up to 1,600 C at pressures in the order of 10^{-6}mm Hg. absolute has been announced by Vacuum Specialties Company, Somerville, Massachusetts.

The indenter is a sapphire point on a molybdenum rod with a 2 kilogram weight. This assembly is mounted on a cross feed table, operated from outside the vacuum chamber, with micrometer adjustments, so that a great many closely spaced indentations can be made on one or more samples held in the anvil without losing temperature or vacuum.

The hot zone consists of a tantalum resistance heating element surrounded by a group of tantalum and stainless steel heat shields. Maximum temperature obtainable is in excess of 2,000 C.



The testing chamber is pumped by a 6 in. fractionating type oil diffusion pump with a liquid nitrogen trap to insure the required degree of vacuum and minimize the backstreaming of contaminants into the tank from the pumping system. The entire pumping system is operated from the main control panel.

For further information circle No. 20

HEAT AND CORROSION RESISTANT

CASTINGS & FABRICATIONS

LINDBERG TRAY and BASKET

This combination light-weight cast tray and wire mesh basket is designed for use with the Lindberg carbonitriding furnace. The Tray, weighing only 65 pounds, incorporates all the General Alloys features — such as cored intersections, full radii on all corners and edges, separate shoe arrangement, 60 Ni.-15 Cr. alloy — which provide maximum resistance to atmosphere and quenching. The Basket utilizes the inherent advantages of *combination cast and fabricated* alloy. It is made of wire mesh with a cast top ring, which minimizes distortion. Baskets can be supplied in varying heights and with varying sizes of wire, mesh openings and frames, to suit any load condition. Both tray and baskets can be delivered from stock.

GENERAL ALLOYS COMPANY

FABRICATED ALLOY DIVISION

390 WEST FIRST STREET • BOSTON 27, MASSACHUSETTS

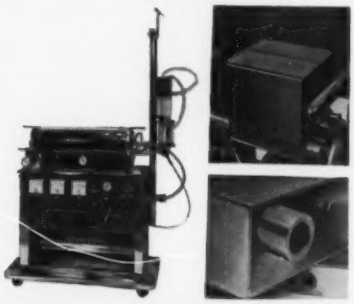
Special Announcement! Giant-size *Tublarform* Heat Treat Fixtures, ranging in sizes up to 6′ diameter x 16′ high, for treating *missile bodies and rocket motor housings* will be on display at General Alloys' exhibit at the Metal Show . . . . Booth No. 548.

Medical-Metal Effort

High Vacuum Equipment Corporation of Hingham, Massachusetts, through its subsidiary, Kinetics Corporation, and the Mark Company, a Division of Image Transfer Inc., of Randolph, Massachusetts, have joined forces in solving the troublesome problem of joining stainless steel components in artificial heart-lung machines, the substitute for the human heart and lungs during open heart surgery.

Heretofore conventional welding techniques have been considered unsatisfactory because of ever-present microscopic cracks in the joint area and the excessive grinding and polishing necessary to achieve the almost perfect finish required on this equipment. Torch brazing was unsatisfactory because of the toxic constituents present in low temperature braze filler metals and fluxes.

The new technique evolved by the Kinetics Corporation in the brazing of stainless steel and superalloy components of aircraft gas turbines, nuclear reactors, missile and electronic components is now employed in the production of the artificial heart-lung machine. A



filler metal, composed primarily of nickel, is preplaced at the joint area and brazing takes place in a vacuum furnace at temperatures of 1,800 to 2,200 F. An atmosphere equivalent to that encountered about 120 miles off the surface of the earth is maintained during the brazing cycle. This technique produces a void-free bond with smooth fillets at both sides of the joint. The absence of air or other contaminants in the furnace during the brazing cycle renders flux unnecessary. Since the filler metal approximates the composition of the stainless steel being joined, an excellent color match is obtained. Skillful polishing of the finished product produces a homogenous appearance.

For further information circle No. 21

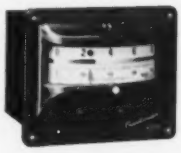
Sunbeam Appoints Etter

Sunbeam Equipment Company, Meadville, Pennsylvania, has announced the appointment of Etter Engineering Company, New Haven, Connecticut, to handle their line of industrial heat process furnace equipment in the states of Connecticut, Massachusetts, Rhode Island, New Hampshire, Vermont and Maine.

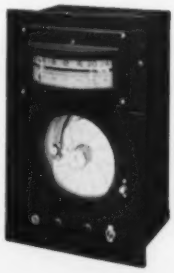
The appointment of Etter Engineering as Sunbeam's representative is calculated to give a more complete merchandising approach to the firm's sales picture.

For further information circle No. 22

Gardsman by WEST



STEPLESS Controllers (Model JSB) infinitely modulate electric heat. No on-off pulses. Prolongs heater-life, saves power. Exclusive manual switch, adjustable maximum and minimum input control. *Tubeless.* Compact. Least maintenance and operating attention required.



PROGRAMMER (Model JSBG Stepless) for the most *precise* control of temperature-time cycle, integrated by simply cut cam. Most compact. Can also control secondary operation at any point in the time cycle. Program Controllers are also available with other control forms:— (Off-On, Proportioning, etc.) Ask your West representative or write direct for Bulletins JSB and JG.

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SALES OFFICES IN PRINCIPAL CITIES

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British Subsidiary:
WEST INSTRUMENT LTD.,
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See us at the ISA Instrument-Automation Conference & Exhibit, San Francisco, California, Brooks Hall, May 10-12, 1960, Booth 419-421

the trend is to WEST

STOP SCALING CARBURIZATION & DECARBURIZATION DURING HEAT TREATING

MARKAL "C-R" COATINGS

protect against oxidation, corrosion, scaling, gas absorption, carburizing and decarburizing during heat-treating, annealing, normalizing or stress-relieving.

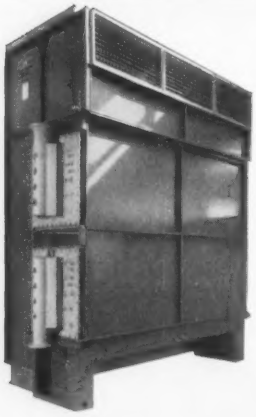
MARKAL "C-R" Coatings protect up to 2100° F. steel, stainless steel, copper, copper bronze, nickel bronze, titanium, zirconium, titanium and molybdenum alloys, inconel and monel metals during heat-treating.

MARKAL "C-R" Coatings can be removed easily from surface after operation is completed, in most instances.

Write on company letterhead for complete information. Engineering service available for special problems.

The Mark of Quality . . . MARKAL Protective Coatings

MARKAL COMPANY 3102 West Carroll Avenue, Chicago 12, Illinois



You Get Better Results IN HEAT TREATING!

● Use the NIAGARA AERO HEAT EXCHANGER to control the temperature of your quench bath and you remove the heat *at its rate of input,* always quenching at the exact temperature that will give your product the best physical properties.

The Niagara *Aero* Heat Exchanger transfers the heat to atmospheric air by evaporative cooling. It extends your quenching capacity without using extra water. It pays for itself with water savings.

You can cool and hold accurately the temperature of all fluids, gases, air, water, oils, solutions, chemicals for processes and coolants for mechanical and electrical equipment. You get closed system cooling, free from dirt and scale.

Write for Bulletins 120, 124, 132

NIAGARA BLOWER COMPANY

Dept. MG-4, 405 Lexington Ave., New York 17, N. Y.

District Engineers in Principal Cities of U. S. and Canada

Metal Awards Honors

Three new ASM Metal Awards have been established by the Trustees of the American Society for Metals, according to an announcement by Allan Ray Putnam, ASM managing director.

Two of the new awards will be given in honor of the late William Hunt Eisenman, a founder member of the society and its national secretary for 40 years. The third award is in the name of the late Dr. Marcus A. Grossmann, a past president of the 31,000 member metals engineering society.

The William Hunt Eisenman Enginering Award of the American Society for Metals will be presented each year for outstanding contributions in the practical application of the science of metallurgy to the production of metals or their engineering use.

The Eisenman Teaching Award will be presented to a teacher of long standing reputation through his ability to inspire students and impart enthusiasm and understanding. This will not be necessarily an annual award.

The ASM Trustees established The Marcus A. Grossmann Young Authors Award to encourage creative writing by young metal scientists. The Young Authors Award will be granted to the authors under age 35 of the most outstanding paper in ASM Transactions, the annual record of scientific developments in the field of metals.

For further information circle No. 23

ALL THE BEST HEAT RESISTING ALLOYS

FROM STOCK

Stock List and Literature Available

ROLLED ALLOYS, INC.

Heat and Corrosion Resistant Alloy Specialists

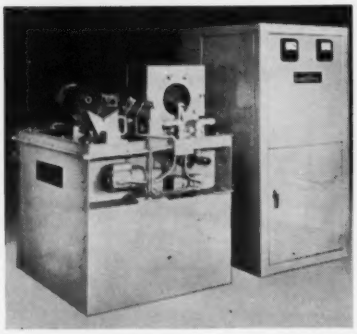
5309 CONCORD AVE. DETROIT 11, MICH.

330 WILLIAM ST. SOUTH RIVER, N. J.

NEWS TO HEAT TREATERS

Roller Treating

A semi-automatic low frequency induction heater for heat treating rollers and wheels has been developed by the Ajax Magnethermic Corporation, Youngstown, Ohio. Power source can be either a direct line 60 cycle or multiductor 180 cycle static frequency converter.



The induction heater features automatic indexing with parts carried to heating coil and quench and returning to unload-reload position. Quenching of one part while another part is heating provides continuous production.

The machine is designed to heat track rollers, crane wheels, and other similar parts in diameters ranging from 6 in. to 14 in. Low frequency induction heating equipment obtains high efficiency at low initial cost.

Heat treating with this system is fast, as few parts are in process and practically no scale or decarburization is produced. Residual stresses are minimized without danger of hardening the bore or other hub sections which may be subsequently machined.

For further information circle No. 24

Norton Finish Pins

Bonded shapes for abrasive tumbling, manufactured by Norton Company, now include round and triangular pins, especially designed for barrel finishing intricate parts.

Continued on page 47

For almost every hardness testing requirement

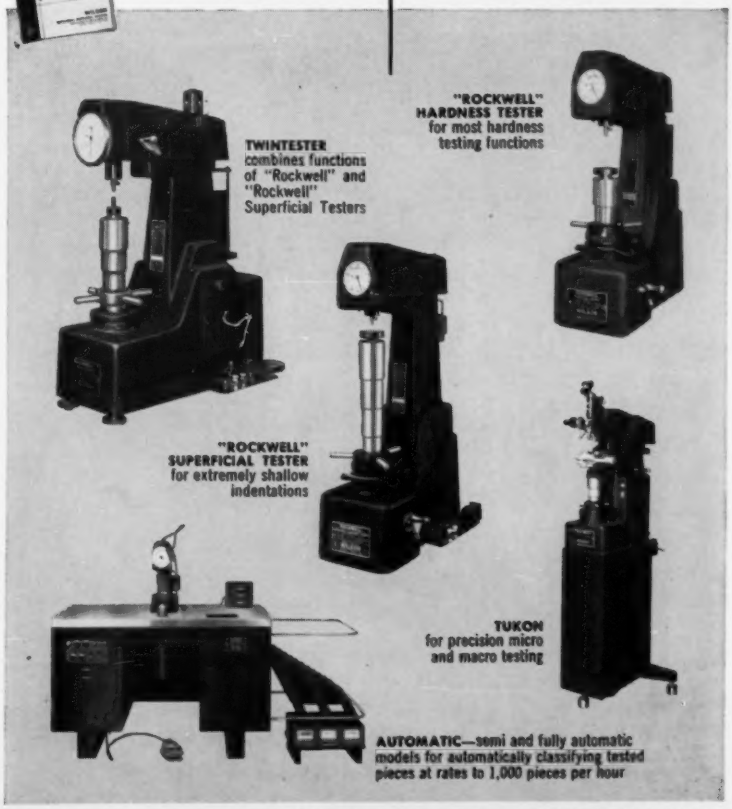
There's a Wilson "Rockwell" instrument to do the job

Wilson "Rockwell" Hardness Testers can help make your products better, stronger, longer lasting. They give reliable results on the production line, in laboratories, in tool rooms, and in inspection departments. They're as easy to use as a center punch, as durable as a machine tool, as sensitive and accurate as a precision balance. That's why Wilson "Rockwell" is recognized as the world's standard of hardness testing accuracy.

Write for Catalog RT-58. It gives complete details on the full line of Wilson hardness testing equipment.

Wilson "Brale" Diamond Penetrators give Perfect Readings

A perfect diamond penetrator is essential to accurate testing. Only flawless diamonds are used with Wilson "Brale" penetrators. Each diamond is cut to an exact shape. Microscopic inspection and a comparator check of each diamond—one by one—assure you of accurate hardness testing every time.

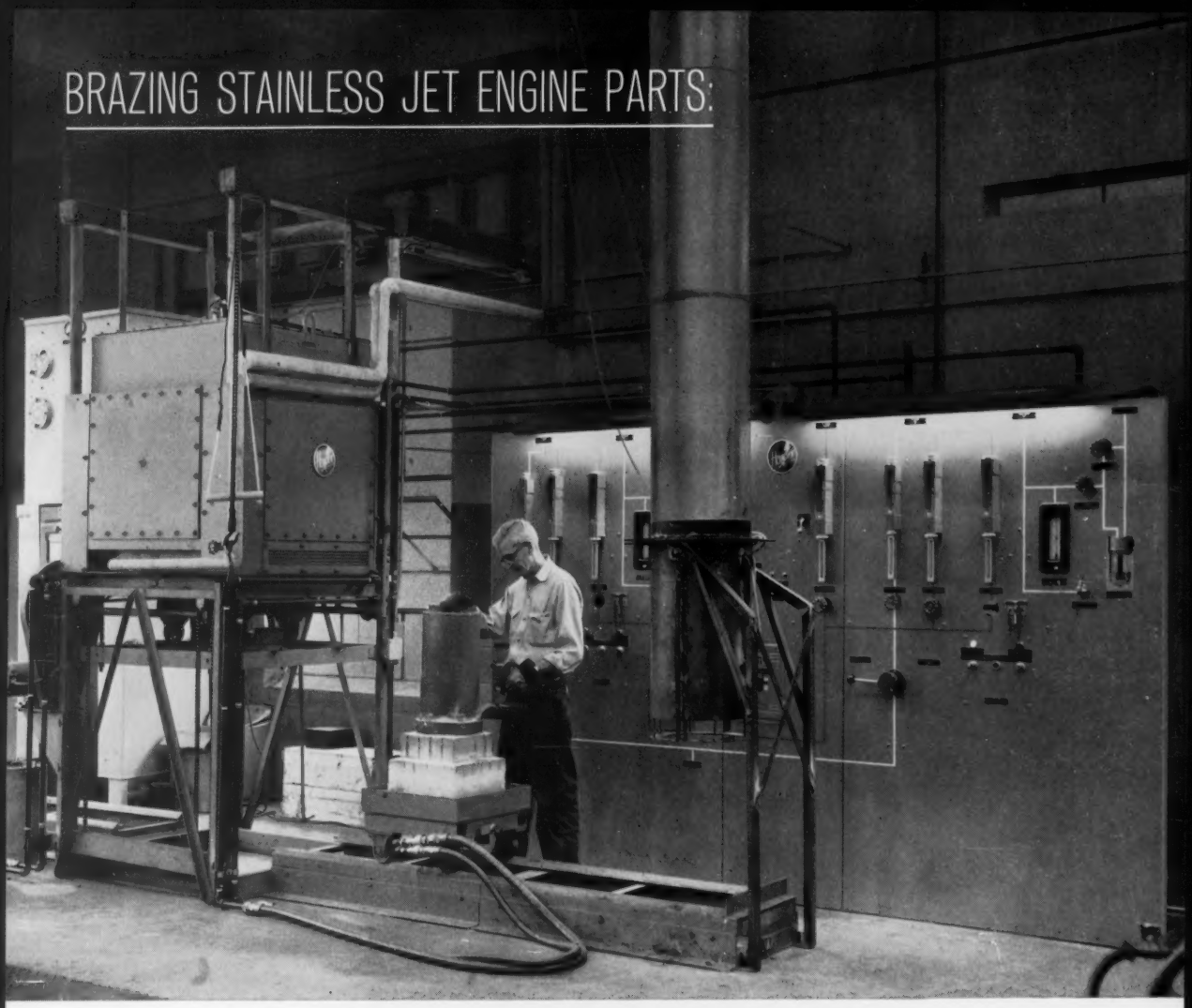

TWINTESTER
combines functions of "Rockwell" and "Rockwell" Superficial Testers
"ROCKWELL" HARDNESS TESTER
for most hardness testing functions
"ROCKWELL" SUPERFICIAL TESTER
for extremely shallow indentations
TUKON
for precision micro and macro testing
AUTOMATIC—semi and fully automatic models for automatically classifying tested pieces at rates to 1,000 pieces per hour

WILSON "ROCKWELL" HARDNESS TESTERS

ACCO

Wilson Mechanical Instrument Division
American Chain & Cable Company, Inc.
230-R PARK AVENUE, NEW YORK 17, NEW YORK

BRAZING STAINLESS JET ENGINE PARTS:



REJECTS MINIMIZED, UTMOST SAFETY ASSURED

Serving a major aircraft and automotive parts manufacturer, this Harper Elevator Furnace can be relied upon for top-caliber dry hydrogen brazing *on every run.* What's more, it's built for "fail-safe" operation.

In the application shown above, fluxless copper brazing and bright hardening are performed simultaneously within retorts to produce stainless steel jet engine sub-assemblies. The furnace is also utilized regularly for nickel alloy brazing and annealing a variety of other stainless steel parts. According to the user, there have been practically no rejects or reruns.

One big reason behind this success is the modern gas flow control panel which was designed and supplied by Harper for governing atmosphere gases. With valves, flow meters, manometers, bubble bottles and test cocks neatly mounted and well illuminated, flow rates and pressures can be readily checked and adjusted.

Safety is provided in a most positive way. For example, if the hydrogen pressure or the power supply fails, a safety solenoid shut-off valve automatically cuts off the hydrogen line, starts nitrogen flow and sounds a horn alarm. ***Nothing is left to chance.***

When you first plan to braze, anneal or harden stainless steel parts, you'll find it pays to talk it over with a Harper representative . . . for Harper can build the furnace best suited to your needs: box, pusher, hump mesh belt, roller hearth, bell, elevator or pit.

Harper's new booklet, "How to Braze Stainless Steels," is yours for the asking. Write. Harper Electric Furnace Corp., 51 River St., Buffalo 2, N. Y.

HARPER ELECTRIC FURNACES

FOR BRAZING, SINTERING, WIRE ANNEALING, BRIGHT ANNEALING, FORGING AND RESEARCH

NEWS TO HEAT TREATERS

Continued from page 45

The abrasive pins were developed to finish hard-to-reach areas of serrated or grooved machined pieces which have proved difficult to finish completely with the previously available tumbling abrasive, molded triangles or spheres.

The new shapes are designated Tumblex RP (round pin) and Tumblex TP (triangular pin) abrasive. The round pins are presently available in standard ⅝ in. length in diameters of 3/16 in. and ⅜ in. The triangular pins are 1 inch long and ⅜ in. on the sides.

Tumblex RP abrasive is well suited to finishing parts with round holes or circumferential grooves. Tumblex TP abrasive is particularly suited to finishing slotted parts because the 60 degree edge angle presented to the work gets into the inside right angle corners which square or round edges of other finishing media cannot touch.

All Tumblex abrasive shapes are designed for the mass processing of ferrous and non-ferrous metals, to remove burrs, *heat treat scale*, refine surfaces and form radii. This method replaces many hand deburring and polishing operations, resulting in lower finishing costs.

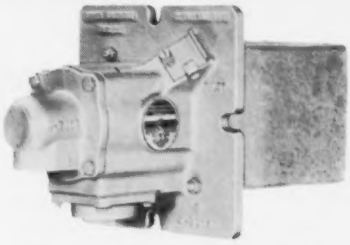
Extensive testing has proved that the fatigue limit of hardened steel parts can be improved as much as 20% by barrel finishing.

For further information circle No. 25

Better Heat Control

Uniform furnace temperature for heat treating processes, regardless of uneven loading, may now be obtained by using excess air with North American Manufacturing's new series 4423 Sealed-in Nozzle Mix Gas Burner. Uniform temperature is achieved by lowering gas intake while maintaining an excess air rate.

Simplified design, combining a rugged cast-iron mounting plate and burner body into one piece with 9 in. burned ceramic tile attached, provides solid construction. Provision is also made for a flame monitoring device to assure flame safety. Either an interrupted or constant pilot may be used.



The largest size burner, 1½ in., can have its fuel input turned down from 431 cfh to 52 cfh of natural gas when using 16 osi air pressure. This results in an available heat turndown ratio of 150 to 1 in a 675 F. furnace. The hot mix temperature then issuing from the tile is less than 700 F. and the flame is entirely in the tile.

This burner is available with air pipe sizes of ¾" to 1½". A range of 70,800 to 431,000 Btu per hour is possible at an air pressure of 16 osi.

For further information circle No. 26

Hardened At 900 ZPH

A unique, high-speed machine which can harden two bearing zones of a starter motor shaft at the rate of 900 zones an hour is now being used by one of the country's leading automotive manufacturers. The

machine hardens two different shafts at one time—the longer shaft requiring two hardened areas, the shorter shaft only one.

Induction Heating Corporation, of Brooklyn, designed and built the equipment which is hopper fed, has an automatic unload and can be operated by unskilled labor. The two shafts are indexed by conveyor and rotated during heating and quenching to insure uniform hardness. At the end of the heating and quenching operation, the machine ejects the finished parts and the conveyor indexes for the next two shafts.

For further information circle No. 27

New Cress Models

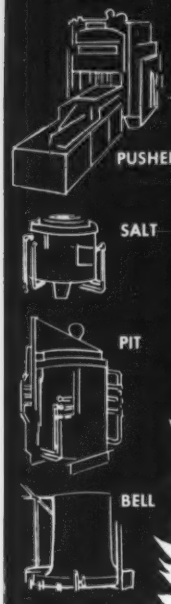
J. J. Cress Company, Incorporated, Monrovia, California, has introduced two new model electric heat treating furnaces. These units feature two unique thermostatic controls which provide accurate temperature control over the range of 400 F. to 1,800 F. at a moderate price.

An easily operated, counter balanced door, rises vertically on a lever arrangement. In addition, a high degree of insulation is achieved by use of low K factor insulating brick backed up by block insulation.

Switches, mercury contactors and control are all located in ventilated furnace base.

For further information circle No. 28

MEET ALL TYPE FURNACE FIXTURE NEEDS... ECONOMICALLY.



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Any form, size, weight, strength, mesh, alloy or quantity.

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An easy to use, economical, dry powder applied to steels before heat treating can save costly hours of grinding, polishing, buffing.

Recommended for all materials to be stress relieved, annealed and hardened at temperatures up to 1650° F., PBC is easy to use, requires no experience, just follow simple directions.

Available in 2 pound, 5 pound, 15 pound cans and in 25 pound drums.

BENEFIT THESE 4 WAYS . . .

1. Prevents pitting, scale formation and decarburization.
2. Helps eliminate costly polishing, grinding and buffing operations.
3. Completely sealed from detrimental atmosphere.
4. Increases furnace capacity by eliminating time and space consuming packs.

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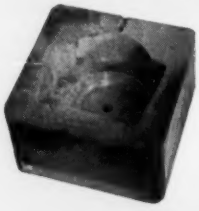
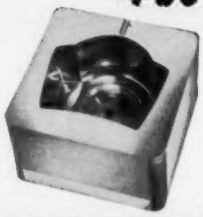


RESULTS USING *PBC



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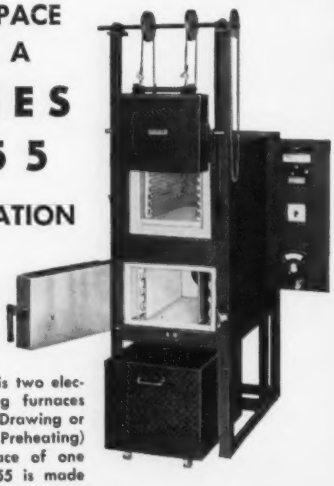

The Series 8055 is two electric heat treating furnaces (Hardening and Drawing or Hardening and Preheating) in the floor space of one furnace. The 8055 is made in nine standard sizes or to your specifications. Furnaces operate on standard line voltage . . . no transformer necessary . . . all controls included. Each furnace is independently controlled permitting two operations to be performed at the same time. Write, wire or call . . .

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MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

A Two Page Data Sheet which describes its Speedomax H indicators, recorders and controllers for pH and redox is being offered by Leeds and Northrup Company. In addition to outlining specifications of the instruments, such as pH ranges and chart speeds, the sheet includes a chart which lists types of control action obtainable. A wire diagram for installation of instrument components is also included.

For further information circle No. 29

"Lindberg-Upton Salt Bath Furnaces" is the title of a bulletin available from Lindberg Engineering Company. This brochure describes and illustrates the unique advantages of the exclusive graphite "continuing" electrodes in salt bath furnaces. The brochure also describes and illustrates high and low temperature salt bath furnaces for any production, pilot plant or laboratory use available from Lindberg Engineering Company.

For further information circle No. 30

A Folder on Induction Heating Equipment for automated metal heating has been published by Robotron Corp., Detroit, Michigan. The brochure explains company technical services available to the customer: problem analysis, research, design engineering and manufacture of tailor-made end product, with illustrations of facilities and equipment to do the job. Also illustrated are some of Robotron's standard induction heating units including motor generator sets, control stations and fixed-installation as well as portable heating stations.

For further information circle No. 31

An Eight Page Booklet from the Ajax Magnethermic Corporation, Youngstown, Ohio, illustrates different types of induction heating equipment and applications: billet heating for extrusion or forging; heat treating, annealing, and hardening; joining, brazing or soldering; melting, vacuum, or air melting; and sintering. Data includes: selection chart for billet heaters, melting rates in pounds per hour, table of frequencies, and individual product specifications.

For further information circle No. 32

A Specification Sheet on the new 58-HD vacuum hot hardness testing furnace that includes complete engineering data on construction and performance is now available from the Marshall Products Company. Introduced earlier this year, the 58-HD furnace was designed for hardness tests on metals at temperatures up to 3,000 F. in a vacuum range of 1×10^{-4} mm. mercury. Free copies of this sheet (No. 824-A) are available.

For further information circle No. 33

Heat Treat Review has made available several of its articles which should be of interest to readers. They are: a fully illustrated, three page article devoted to a discussion of non-ferrous metal heat treating and the application of prepared gas atmospheres, and an article which describes the need for flexible equipment in job-shop operations. It also tells how a commercial heat treating concern devised a heat treating line which economically incorporated this feature.

For further information circle No. 34

Old as the Hills is the title of a film being distributed as part of the celebration of its 75th anniversary by the Norton Company. The film is designed for showings to a variety of general audiences throughout the country. "Old As The Hills" tells the story of abrasion, as old as the hills themselves. It shows how nature, in roaring mountain streams, angry seas and eroded hills taught the lesson of abrasion, then in deposits of natural abrasives provided the material for man's first grinding needs, sharpening crude tools and polishing armor. The film then goes on to outline man's progress in adapting the lessons and materials of the earth in shaping his own environment to match his growing needs and desires.

Some of the highlights of scenes in the film are: colorful scenes of typical New England scenery showing the abrasive forces of nature at work before the coming of man; man's first uses of abrasive materials portrayed in scenes of 18th century American life taken at Old Sturbridge Village, Sturbridge, Massachusetts, a recreated New England Village and noted tourist attraction.

For further information circle No. 35

Metal Treating
THE ONLY MAGAZINE DEVOTED EXCLUSIVELY TO THE HEAT TREATING INDUSTRY

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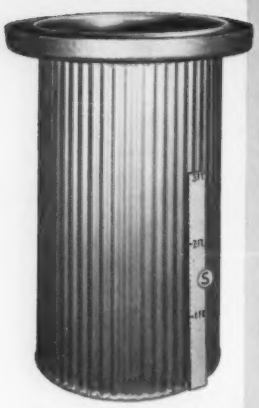

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CINCINNATI "oscillating" Flamatic

uniformly hardens 2 sizes of steering control arm shafts simultaneously

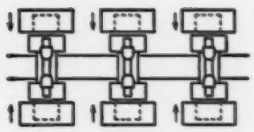
430 parts hardened per hour of one size;
125 per hour of a larger size

For high production surface hardening of two sizes of steering knuckle control arm shafts, a major automobile manufacturer has installed the Cincinnati® Flamatic® Flame Hardening Machine shown below.

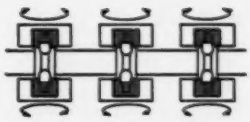
This Flamatic, fueled by city gas and oxygen, has two independent heating stations. The right-hand station selectively hardens both ends of three shafts simultaneously; the left-hand station hardens both ends of one shaft. Thus one machine processes two similar parts having widely different production quantity requirements. Operating sequence of the three-at-a-time station is described at right.

The part, of 1045 Steel, sectioned to show the hardness pattern, is illustrated above. Specified areas to be hardened include the threaded section, fillet, and square shoulder, at both ends. Minimum depth of case produced is .016″ below thread root, .030″ at fillet, with minimum hardness of 55Rc.

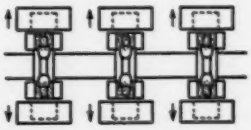
This Flamatic met the heat treating and production rate specifications of these critical parts. To solve your heat processing problems, call in a Meta-Dynamics Division field engineer. Cincinnati builds *both* flame heating and induction heating machines for high production as well as varied, short-run work.



1. Operator loads three shafts on locating pins of chain conveyor. Parts index to three opposed pairs of flame heads.



2. Flame heads ignite and advance to surround both ends of each shaft. Flame heads oscillate to provide uniform heating of all surfaces to be hardened.



3. Flame is extinguished and flame heads retract. Quench heads advance and apply soluble oil spray.

4. Quench is cut-off and quench heads retract. Conveyor indexes next three parts and sequences repeat.

inductron flamatic
hardening machines

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Machines for Metal Forming and Heat Treating

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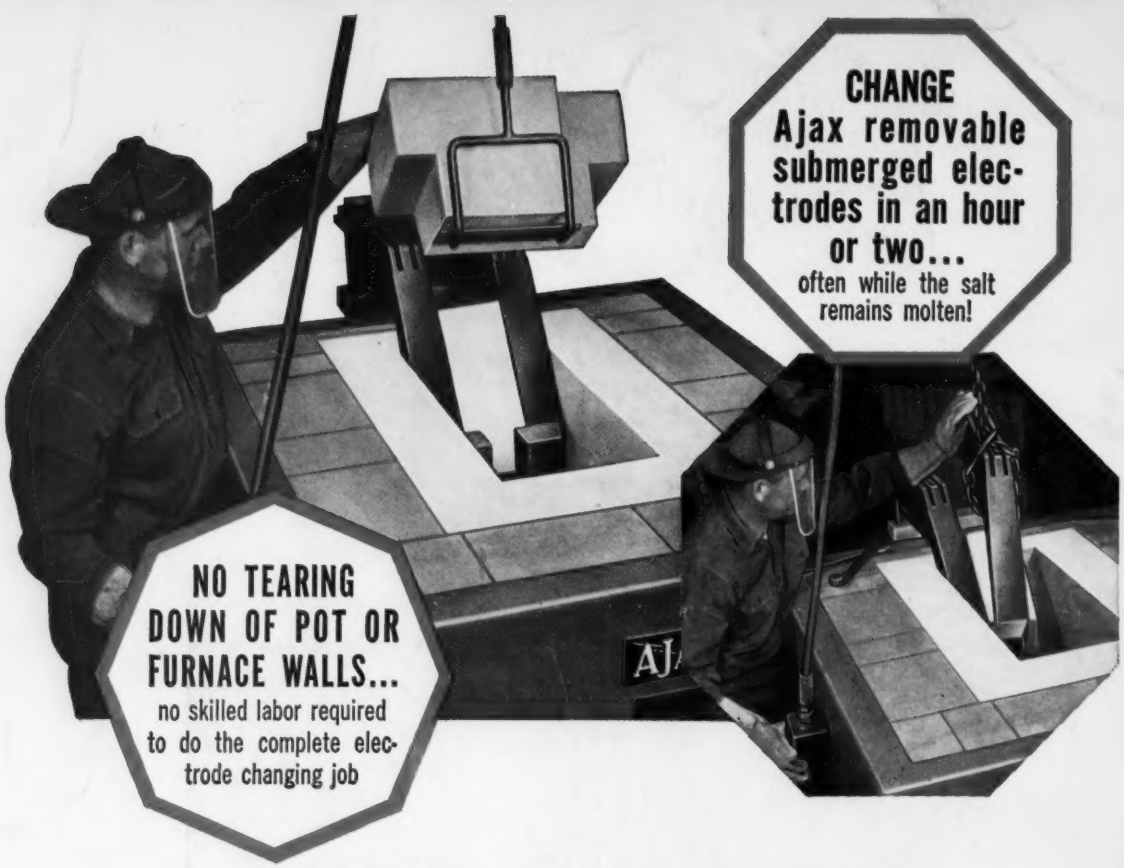
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Ajax removable submerged electrodes in an hour or two...
often while the salt remains molten!
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no skilled labor required to do the complete electrode changing job

This Ajax development

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Largest line of types, shapes and sizes, manual or mechanized, for modern production requirements.

Avoids production tie-ups, too!

Now you get all the advantages of closely spaced, vertical submerged electrodes in your salt bath furnace — with almost none of the previous high cost or time loss in putting in new ones. Simply lift a removable block on top of the furnace and the electrodes are fully accessible for a fast, easy change by unskilled labor.

Now widely used on new Ajax electric salt bath furnaces, this feature can often be added to old ones at moderate cost. And here's still another heat treating maintenance tip: Send worn electrodes to Ajax for "restubbing." They come back to you good as new — at a substantial saving over the price of new ones!

Write for Removable Submerged Electrode Bulletin 810.

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